

HP SureStore Virtual Arrays

7100 & 7400

User's & Service Guide

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WARNING:	Indicates procedures or practices which, if not observed, could result in personal injury.
CAUTION:	Indicates procedures which, if not observed, could result in damage to equipment or loss of data.
NOTE:	Indicates important information or operating instructions.
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Warranty Information

Standard Limited Warranty

The HP SureStore Virtual Arrays 7100 and 7400 standard warranty includes the following:

- Three year limited warranty
- Next day on-site service for certain repairs (not available in certain geographic areas*; see table below)

See the “Hewlett-Packard Hardware Limited Warranty” on the following page for a complete description of the standard warranty.

*In HP-Excluded Travel Areas (where geographical obstacles, undeveloped roads, or unsuitable public transportation prohibit routine travel) service is provided on a negotiated basis at extra charge. However, HP SupportPacks and other enhanced services may follow different guidelines. Contact you authorized HP reseller for more information.

Zone	Distance from HP Office	Response Time
1 – 3	100 miles (160 km)	Next business day
4 – 5	200 miles (320 km)	Second business day
6	300 miles (480 km)	Third business day
	> 300 miles (480 km)	To be negotiated

Warranty Upgrades

HP offers SupportPack warranty upgrades to provide a higher level of response or repair time commitment for your HP SureStore Virtual Arrays 7100 and 7400. For more information on upgrading your warranty, contact your local HP sales representative or authorized reseller.

Warranty Contacts U.S. and Canada

For hardware service and telephone support, contact:

- An HP-authorized reseller
- or
- HP Customer Support Center at 970-635-1000, 24 hours a day, 7 days a week, including holidays

Current Support Information

For the latest support information, visit the following web site:

<http://www.hp.com/support/va7100>

Preparing for a Support Call

If you must call for assistance, gathering the following information before placing the call will expedite the support process:

- Product model name and number
- Product serial number
- Applicable error messages from system or diagnostics
- Operating system type and revision
- Applicable hardware driver revision levels (for example, the host adapter driver)

Hewlett-Packard Hardware Limited Warranty

HP warrants to you, the end-user Customer, that HP SureStore Virtual Arrays 7100 and 7400 hardware components and supplies will be free from defects in material and workmanship under normal use after the date of purchase for *three years*. If HP or Authorized Reseller receives notice of such defects during the warranty period, HP or Authorized Reseller will, at its option, either repair or replace products that prove to be defective. Replacement parts may be new or equivalent in performance to new.

Should HP or Authorized Reseller be unable to repair or replace the hardware or accessory within a reasonable amount of time, Customer's alternate remedy will be a refund of the purchase price upon return of the HP SureStore Virtual Arrays 7100 and 7400.

Replacement Parts Warranty	HP replacement parts assume the remaining warranty of the parts they replace. Warranty life of a part is not extended by means of replacement.
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Items Not Covered	Your HP SureStore Virtual Arrays 7100 and 7400 warranty does not cover the following: – Products purchased from anyone other than HP or an authorized HP reseller – Non-HP products installed by unauthorized entities – Consumables, such as batteries – Customer-installed third-party software – Routine cleaning, or normal cosmetic and mechanical wear – Damage caused by misuse, abuse, or neglect – Damage caused by parts that were not manufactured or sold by HP – Damage caused when warranted parts were repaired or replaced by an organization other than HP or by a service provider not authorized by HP
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About This Guide

This guide is intended for use by information technology (IT), service, and other personnel involved in managing, operating, servicing, and upgrading the HP SureStore Virtual Arrays (VA) 7100 and 7400. It is organized into the following chapters:

Chapter 1. Product Overview	Describes the features, controls, and operation of the disk array.
Chapter 2. System Configurations	Guidelines for designing array configurations for different system requirements.
Chapter 3. Troubleshooting	Instructions for isolating and solving common problems that may occur during array operation
Chapter 4. Servicing & Upgrading	Instructions for removing and replacing all field replaceable units.
Chapter 5. Specifications & Regulatory Statements	Product dimensions, weight, temperature and humidity limits, shock and vibration limits, electrical and power specifications, regulatory and safety statements, and Declaration of Conformity.

Related Documents and Information

The following items contain information related to the installation, configuration, and management and of the VA 7100 and VA 7400:

- *HP SureStore Virtual Arrays 7100 & 7400 Installation Guide* - includes step-by-step instructions for installing and configuring the hardware and software components of the VA 7100 and VA 7400 enclosures.
- *HP SureStore Virtual Array Family Rack Installation Guide* - includes step-by-step instructions for installing the VA 7100 and VA 7400 enclosures into HP Rack System/E, HP System racks, and Compaq 9000 racks.
- *HP SureStore Command View SDM Installation and User Guide* - describes how to install and use the HP SureStore Command View SDM software and its associated utilities to configure, manage, and diagnose problems with the array.

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1. Product Overview

Product Description

The HP SureStore Virtual Arrays (VA) 7100 and 7400 are Fibre Channel disk arrays that feature scalability, high performance, and advanced data protection. The VA 7100 includes only one “Virtual Array” or controller enclosure. The VA 7400 includes one controller enclosure and up to six “Disk System” enclosures or JBOD (Just a Bunch of Disks) enclosures (see Figure 1). Table 1 shows the virtual array product configurations.

Both the controller enclosure and the JBOD enclosure can house up to 15 disk drives in any mix of 18 GB, 36 GB, or 73 GB disk drives. The maximum configuration for a VA 7400 includes 105 disk drives with a total capacity of 7.67 TB. The controller enclosure includes one or two array controller cards that use HP *AutoRAID* technology to automatically select the proper RAID level as data is stored. The JBOD enclosure includes two link controller cards that are used to extend the Fiber Channel loops.

The array can be connected to one or more hosts, hubs, or switches via fiber optic cables. Factory-racked products are shipped pre-configured in HP Rack System/E racks. Field-rackable products are supported in nine racks (see Table 2).

Table 1 Virtual Array Product Configurations

Product No.	Enclosure/ Configurations*	No. of Enclosures	No. of Disks Per Encl.	No. of Array/Link Controller Cards Per Encl.	Memory (MB) Per Array Controller Card
VA 7100	Controller/ Field-Rackable (A), Factory-Racked (AZ), or Deskside (D)	1	4-15	1 or 2 ACCs (1 Gbit/s)	256, 512, or 1024
VA 7400	Controller/ Field-Rackable (A) or Factory-Racked (AZ)	1	10-15	2 ACCs (1 or 2 Gbit/s)	512 or 1024
VA 7400	JBOD/ Field-Rackable (A) or Factory-Racked (AZ)	0-6	2-15	2 LCCs (1 Gbit/s)	N/A

*All enclosures shipped with 2 power modules and 2 power cords.

**VA 7400 can have 0 to 6 JBODs connected to the main controller enclosure.

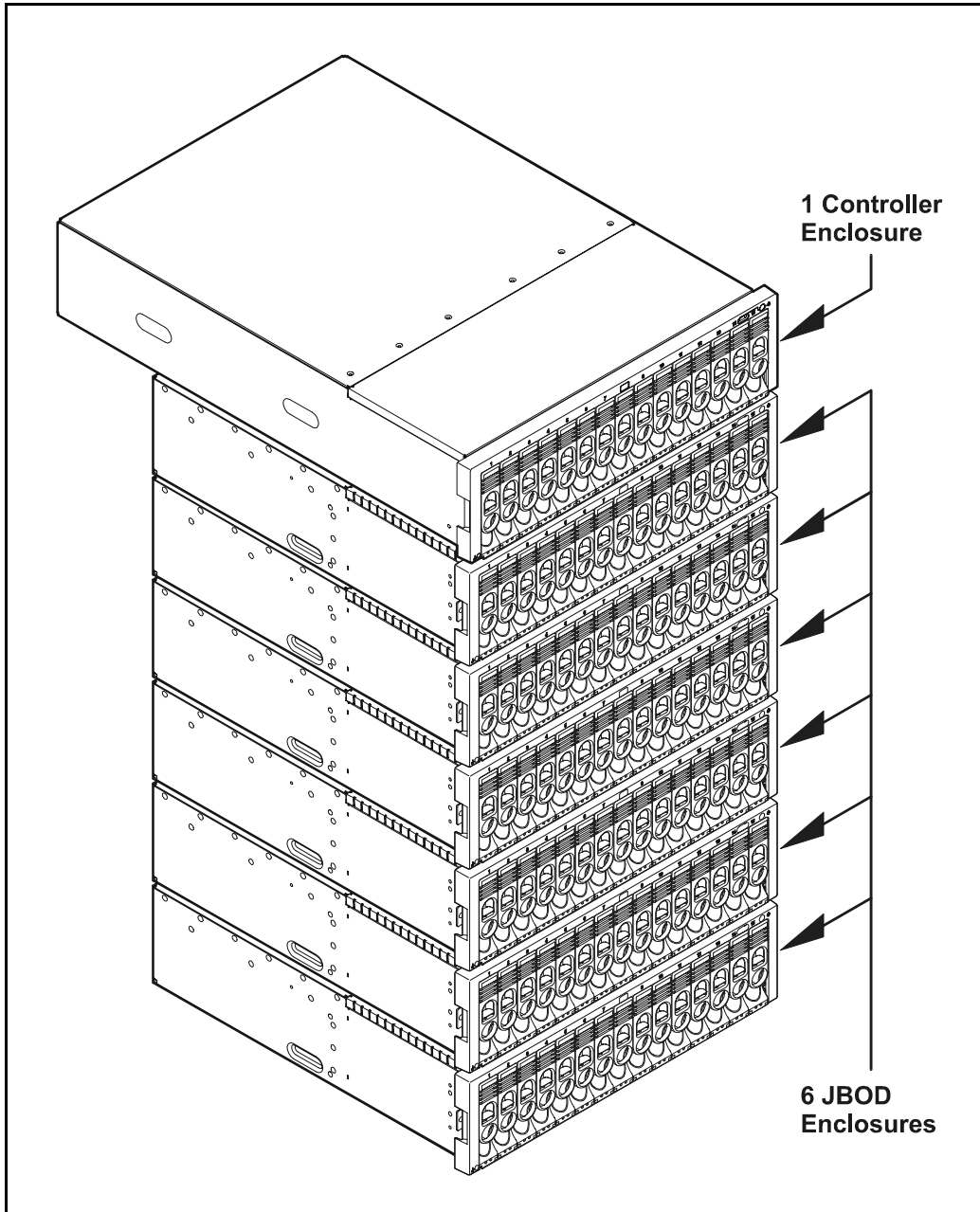


Figure 1 VA 7400 Maximum Configuration

Table 2 Virtual Array Supported Racks

Rack Product No.	Rack Name	Height meters/ EIA Units	No. of EIA Units per Array ¹	No. of Arrays per Rack ²
J1500A	HP Rack System/E41	1.96 m/ 41 U	3	13
J1501A	HP Rack System/E33	1.60 m/ 33 U	3	11
J1502A	HP Rack System/E25	1.25 m/ 25 U	3	8
E3660B	HP System Rack	1.10 m/ 21 U	4	5
E3661B	HP System Rack	1.60 m/ 32 U	4	8
E3662B	HP System Rack	1.96 m/ 41 U	4	10
9142	Compaq 9000 Rack	2.0 m/ 42 U	3	14
9136	Compaq 9000 Rack	1.7 m/ 36 U	3	12
9122	Compaq 9000 Rack	1.1 m/ 22 U	3	7

¹HP Computer Cabinet requires a 1U filler panel to hide the mounting rails.

²Does not include space that may be required for PDUs.

Supported Operating Systems

Native Operating Systems

The arrays are supported on the following native operating systems running *HP SureStore Command View SDM* software:

- HP-UX 11.0/11.i: root, boot (servers only), swap, MC ServiceGuard
- Windows NT 4.0: Advanced Server, Enterprise Edition
- Windows 2000: Server, Advanced Server
- Red Hat Linux 6.2/7.0

Non-Native Operating Systems

The following non-native operating systems are only supported using a dedicated management station running *HP SureStore Command View SDM* on the native operating systems:

- Sun Solaris 7/8
- IBM AIX 4.3.3.
- NetWare 5.1.

Array Management Software

HP Surestore Command View SDM (Storage Device Manager) software, shipped with the arrays, is used to configure, manage, diagnose, and monitor the performance of the array. The software runs on all of the supported operating systems, and includes the following utilities:

- Command View Graphical User Interface (CVGUI)
- Command Line User Interface (CLUI)
- Command View User Interface (CVUI)

Product Features

The arrays include the following features:

- Scalability
 - Data storage capacity for VA 7100: 72 GB to 1095 GB; Data storage capacity for VA 7400: 180 GB to 7665 GB data storage capacity (see Table 3).
 - 256 MB to 1024 MB cache memory capacity (per controller)

Table 3 Data Storage Scalability

Product No.	18 GB Disk Drives	36 GB Disk Drives	73 GB Disk Drives
VA 7100	72 GB min 270 GB max	144 GB min 540 GB max	292 GB min 1095 GB max
VA 7400	180 GB min 1895 max	360 GB min 3780 GB max	730 GB min 7665 GB max

- High performance
 - active-active concurrent access (dual controllers)
 - 800 MB/s high-speed bus (N-way bus between controllers)
 - 10 k rpm & 15 k rpm disk drives
 - 1 or 2 Gbit/s native Fibre Channel (host to controllers/controllers to back-end)
 - High performance read/write IOPs and cache hits (see Table 4)

Table 4 Read/Write & Cache Performance

Product No.	Random Reads	Random Writes	Sequential Reads	Sequential Writes	Cache Hits
VA 7100	3,200 IOPs* 3,000 IOPs**	1,600 IOPs* 480 IOPs**	90 IOPs	45 IOPs	12,500 IOPs
VA 7400	8,000 IOPs* 7,500 IOPs**	4,000 IOPs* 1,200 IOPs**	160 IOPs	80 IOPs	22,500 IOPs

*RAID 1+0 only

**RAID 5DP only

- Advanced data protection
 - HP *AutoRAID* technology: RAID 1+0, RAID 5DP
 - dual-port native Fibre Channel disk drives
 - end-to-end checksum for data integrity
 - metadata resiliency
 - hot swappable FRUs
 - mirrored NVSDRAM¹ (for cache, maps, and microprocessor data structures)
 - cache battery backup
 - redundant array controller cards, link controller cards, power supplies, and blowers - no single component point of failure
 - online firmware download

¹Non-Volatile Synchronous Dynamic Random Access Memory is Error Code Correction (ECC) -type 100 MHz with 8 bits for detection and correction of single-bit errors.

Controller Enclosure Components

Figure 2 through Figure 4 show the front and rear panel components of the VA 7100 and VA 7400 controller enclosures.

VA 7100 Factory-Racked & Field-Rackable Controller Enclosure

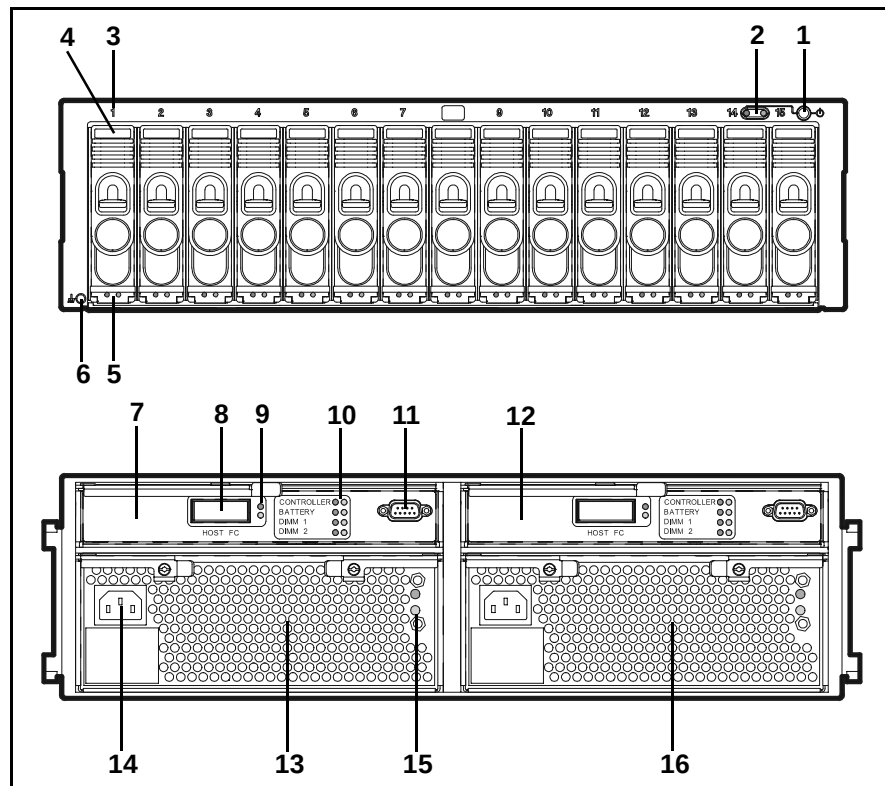


Figure 2 VA 7100 Controller Enclosure (A/AZ)

- | | |
|-------------------------------------|--------------------------------------|
| 1 - Power/Standby Switch | 9 - HOST FC LEDs |
| 2 - System LEDs | 10 - Array Controller LEDs |
| 3 - Disk Drive Slot No. 1 (of 15) | 11 - RS-232 Connector |
| 4 - Disk Drive 1 (of 15) - M/D1* | 12 - Array Controller Card 2 - M/C2* |
| 5 - Disk Drive LEDs | 13 - Power Module 1 - M/P1* |
| 6 - ESD Ground Receptacle | 14 - AC Power Connector |
| 7 - Array Controller Card 1 - M/C1* | 15 - Power Module LEDs |
| 8 - HOST FC Connector - M/C1.H1* | 16 - Power Module 2 - M/P2* |

*Reference designator used in HP SureStore Command View SDM

VA 7100 Deskside Controller Enclosure

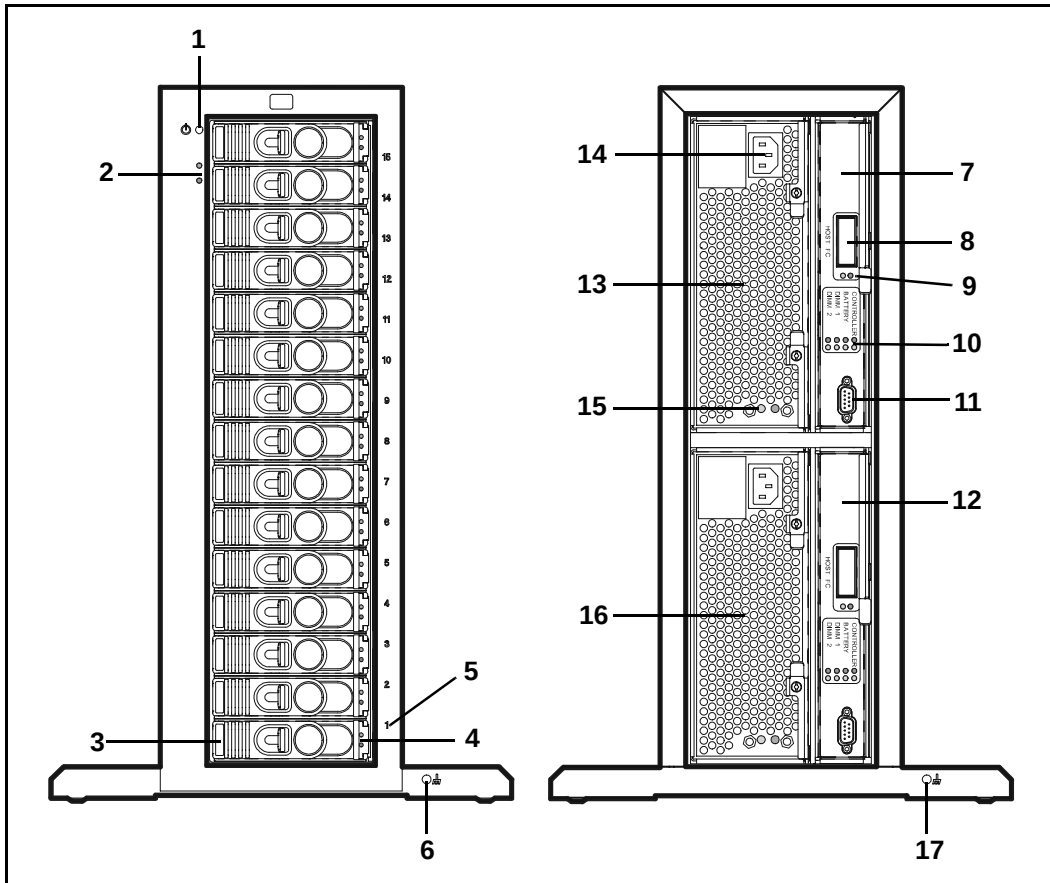


Figure 3 VA 7100 Controller Enclosure (D)

- | | |
|-------------------------------------|--------------------------------------|
| 1 - Power/Standby Switch | 10 - Array Controller LEDs |
| 2 - System LEDs | 11 - RS-232 Connector |
| 3 - Disk Drive 1 (of 15) - M/D1* | 12 - Array Controller Card 2 - M/C2* |
| 4 - Disk Drive LEDs | 13 - AC Power Connector |
| 5 - Disk Drive Slot No. 1 (of 15) | 14 - Power Module 1 - M/P1* |
| 6 - Front ESD Ground Receptacle | 15 - Power Module LEDs |
| 7 - Array Controller Card 1 - M/C1* | 16 - Power Module 2 - M/P2* |
| 8 - HOST FC Connector - M/C1.H1* | 17 - Rear ESD Ground Receptacle |
| 9 - HOST FC LEDs | |

*Reference designator used in HP SureStore Command View SDM

VA 7400 Factory-Racked & Field-Rackable Controller Enclosure

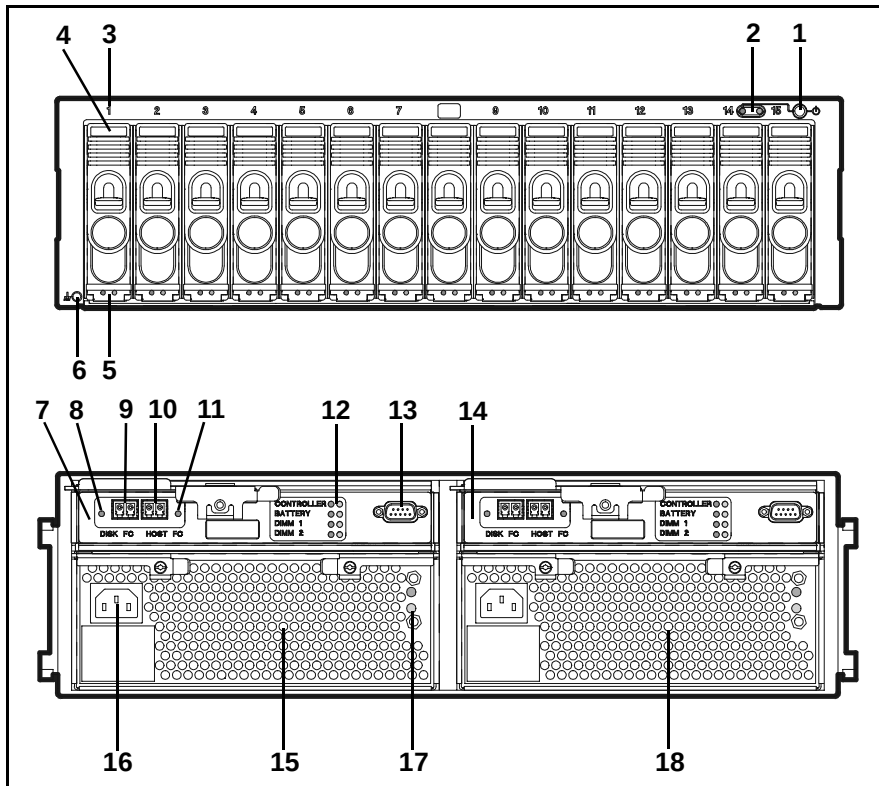


Figure 4 VA 7400 Controller Enclosure (A/AZ)

- | | |
|-------------------------------------|--------------------------------------|
| 1 - Power/Standby Switch | 10 - HOST FC Connector - M/C1.H1* |
| 2 - System LEDs | 11 - HOST FC LED |
| 3 - Disk Drive Slot No. 1 (of 15) | 12 - Array Controller LEDs |
| 4 - Disk Drive 1 (of 15) - M/D1* | 13 - RS-232 Connector |
| 5 - Disk Drive LEDs | 14 - Array Controller Card 2 - M/C2* |
| 6 - ESD Ground Receptacle | 15 - Power Module 1 - M/P1* |
| 7 - Array Controller Card 1 - M/C1* | 16 - AC Power Connector |
| 8 - DISK FC LED | 17 - Power Module LEDs |
| 9 - DISK FC Connector - M/C1.G1* | 18 - Power Module 2 - M/P2* |

*Reference designator used in HP SureStore Command View SDM

Array Controller Card

The array controller card contains the intelligence and functionality required to manage the operation of the array. Its functions include:

- Implementing HP *AutoRAID*™ technology to ensure optimum performance and cost-efficient data storage.
- Managing all communication between the host and the disk drives via single (single array controller) or dual (dual array controller) Fibre Channel arbitrated loops.
- Maintaining data integrity.
- Rebuilding the array in the event of a disk failure.
- Monitoring the operation of all hardware components, including the array controller itself.

In a dual array controller configuration, two controllers provide redundant paths to array data. Dual array controllers operate together in active-active mode, allowing a possible increase in I/O performance, while providing data redundancy. In active-active mode, memory maps on both controllers are constantly and simultaneously updated. By maintaining a mirror image of the maps, the second controller can take over immediately if the first controller fails.

Each array controller card includes the following components:

- 1 or 2 Dual Inline Memory Modules (DIMMs)
- 1 Battery
- VA 7100 Only - 1 Gigabit Interface Converter (GBIC)

DIMMs

Each array controller card includes one or two DIMMs, which contain NVSDRAM (Non-Volatile Synchronous Dynamic Random Access Memory). Because data is spread across all of the disks in the array, the array controller must have a way of determining where each block of data is located. This is accomplished using logical-to-physical data maps stored in NVSDRAM. These maps are vital to managing data; without maps, all data in the array is inaccessible. Table 5 shows the configuration of DIMMs for each controller cache size. In a dual controller configuration, both controllers must have the same cache size.

Table 5 Cache Size and DIMMs

Cache Size (MB)	DIMM Size (MB)	No. of DIMMs
256	256	1
512	512	1
1024	512	2

Battery

NOTE: The array controller battery is a vital and integral part of maintaining the memory maps during a power loss, or any time the array has not successfully completed a Shutdown before power off. If power is lost, and you are not using an Uninterruptible Power Supply (UPS), the battery provides power to the DIMMs to keep valid memory maps of your data.

Each array controller includes a Lithium Ion-type battery with a built-in microprocessor. The battery provides backup power to the DIMMs in the event of a power failure or if array power is switched off. If power is lost, the green BATTERY LED will flash with a 5% duty cycle while powering the DIMMs. A fully charged battery will maintain DIMM memory contents for a minimum of three days. (The three-day specification includes derating for battery life, temperature, and voltage.) If the battery loses its charge, or if it is removed from the controller, the DIMMs will not be powered and memory maps will be lost.

Battery Status. The controller constantly interrogates the battery for its status. If the battery cannot maintain memory contents for a minimum of three days, a warning will notify the operator to replace the battery. Every six months, the battery performs a self-test to determine its charge status. Then it is fully discharged and fully recharged to optimize battery life. This action is not indicated by software or LEDs. In a dual controller configuration, only one battery at a time is discharged and recharged. If the battery becomes discharged during normal operation, the green BATTERY LED will turn off and the amber BATTERY LED will turn on. If the battery has low charge during a power-on self-test, the self-test will halt until the battery is charged to a minimum operating level.

Battery Life. Many factors affect battery life, including length of storage time, length of operating time, storage temperature, and operating temperature. A battery should be replaced if the BATTERY LEDs or the software indicate a battery has diminished storage capacity.

GBIC (VA 7100 Only)

A Gigabit Interface Converter (GBIC) is connected to the HOST FC connector on the VA 7100 array controller card. It functions as a fiber optic transceiver, converting data from an electrical to an optical signal in transmit mode, or from an optical signal to an electrical signal in receive mode. On the VA 7400 array controller card, GBIC circuitry is integrated.

Array Controller Filler Panel

An array controller filler panel is used to fill an empty slot in place of an array controller. A filler panel must be installed to maintain proper airflow in the array enclosure.

CAUTION: Do not operate the array for more than 5 minutes with an array controller or filler panel removed. Either an array controller or a filler panel must be installed in the slot to maintain proper airflow in the array enclosure. Use the foam in the replacement array controller packaging to temporarily plug the array controller slot.

Disk Drives

Both the controller and JBOD enclosures contain disk drives. Disk drives, or “disks”, provide the storage medium for the virtual array. Three types of native Fibre Channel disk drives are supported in the array; disk capacities can be homogeneous, or can be mixed within the array:

- 18 GB 15,000 rpm
- 36 GB 10,000 rpm
- 73 GB 10,000 rpm

A new disk can be added at any time, even while the array is operating. When a disk is replaced, the array applies power to the disk in a controlled manner to eliminate power stresses. The array controller will recognize that a new disk has been added and, if the Auto Include feature is enabled, will include the disk in the array configuration automatically. However, to make the additional capacity available to the host, a new logical drive must be created and configured into the operating system.

A label on the disk drive provides the following information:

- Capacity in gigabytes: 18G, 36G, or 73G
- Interface: FC (Fibre Channel)
- Rotational speed in revolutions per minute: 10K or 15K

NOTE: A red zero (0) on the capacity label distinguishes a disk drive filler panel from a disk drive.

Image Disks

Whenever the array is formatted, the array controller selects two disks as “image disks”. Once selected, the image disks can be moved to any of the other slots without causing a fault. If one of the image disks is removed, the array controller reserves a new image disk. The image disks serve two functions:

- The image disks have space reserved for copies, or “images”, of the data maps in controller cache. During a Shutdown, a complete copy of the maps are stored on both image disks. If the maps are lost, they can be restored from the image disks.
- When resiliency map settings are set to the factory default (Normal Resiliency), changes to the maps, which have occurred since the last Shutdown, are updated every 4 seconds on the image disks.

NOTE: The process of copying the contents of NVSDRAM to the image disks makes the disk set independent of its controller. Because all of the necessary mapping information is on the image disks, it is possible to install a new controller or move the entire disk set to another controller. The new controller will determine that it has a new disk set, and will logically attach itself to those disks.

Disk Drive Filler Panels

Disk drive filler panels are used in both the controller and JBOD enclosures to fill empty slots in place of disk drives. A filler panel must be installed to maintain proper airflow in the enclosure.

CAUTION: Do not operate the array for more than 5 minutes with a disk drive or filler panel removed. Either a disk drive or filler panel must be installed in the slot to maintain proper airflow.

Power Modules

The controller enclosure is shipped with two fully redundant power modules. Each power module contains:

- an autoranging power supply that converts ac input power to dc output power for use by the other array components. The power supplies share the power load under non-fault conditions. If one power supply fails, the other supply delivers the entire load to maintain power for the array. Each power supply uses a separate power cord. Both power supplies can be plugged into a common ac power source, or each supply can be plugged into a separate ac circuit to provide power source redundancy.
- two internal blowers, which provide airflow and maintain the proper operating temperature within the enclosure. If a blower fails, a fault will occur. The other power module will continue to operate and its blowers will continue to cool the enclosure. Even if a power supply fails, both of the blowers within the power module will continue to operate; dc power for the blowers is distributed from the midplane.

JBOD Enclosure Components

Figure 5 shows the front and rear panel components of the JBOD enclosure connected to the VA 7400 controller enclosure.

VA 7400 JBOD Enclosure

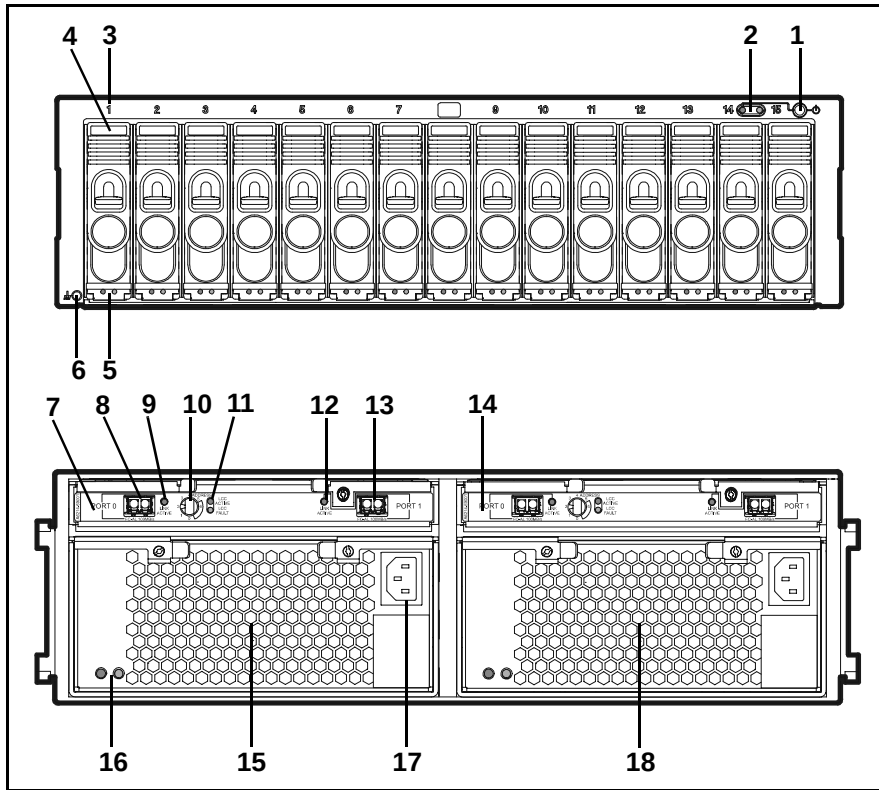


Figure 5 VA 7400 JBOD Enclosure (A/AZ)

- | | |
|---|--|
| 1 - Power/Standby Switch | 10 - ADDRESS Switch |
| 2 - System LEDs | 11 - LCC LEDs |
| 3 - Disk Drive Slot No. 1 (of 15) | 12 - PORT 1 LINK ACTIVE LED |
| 4 - Disk Drive 1 (of 15) - JAn/D1* | 13 - PORT 1 FC-AL Connector - JAn/C1.J2* |
| 5 - Disk Drive LEDs | 14 - Link Controller Card 2 - JAn/C2* |
| 6 - ESD Ground Receptacle | 15 - Power Module 1 - JAn/P1* |
| 7 - Link Controller Card 1 - JAn/C1* | 16 - Power Module LEDs |
| 8 - PORT 0 FC-AL Connector - JAn/C1.J1* | 17 - AC Power Connector |
| 9 - PORT 0 LINK ACTIVE LED | 18 - Power Module 2 - JAn/P2* |

*Reference designator used in HP SureStore Command View SDM

Link Controller Card (VA 7400 Only)

The link controller card (LCC) functions as a fiber optic transceiver for the JBOD enclosure. It allows up to six JBODs to be connected to the controller enclosure. Each LCC includes a Fibre Channel address switch, used to set the Fibre Channel loop address of the card. Each JBOD enclosure must have a unique address and both LCCs in a JBOD must be set to the same address (see Figure 6).

Disk Drives

NOTE: The controller enclosure and the JBOD enclosure both use the same disk drives. See “Disk Drives” in this chapter.

Image Disks

NOTE: The image disks can be located in either the controller enclosure or the JBOD enclosure. See “Image Disks” in this chapter.

Disk Drive Filler Panels

NOTE: The controller enclosure and the JBOD enclosure both use the same disk drive filler panels. See “Disk Drive Filler Panels” in this chapter.

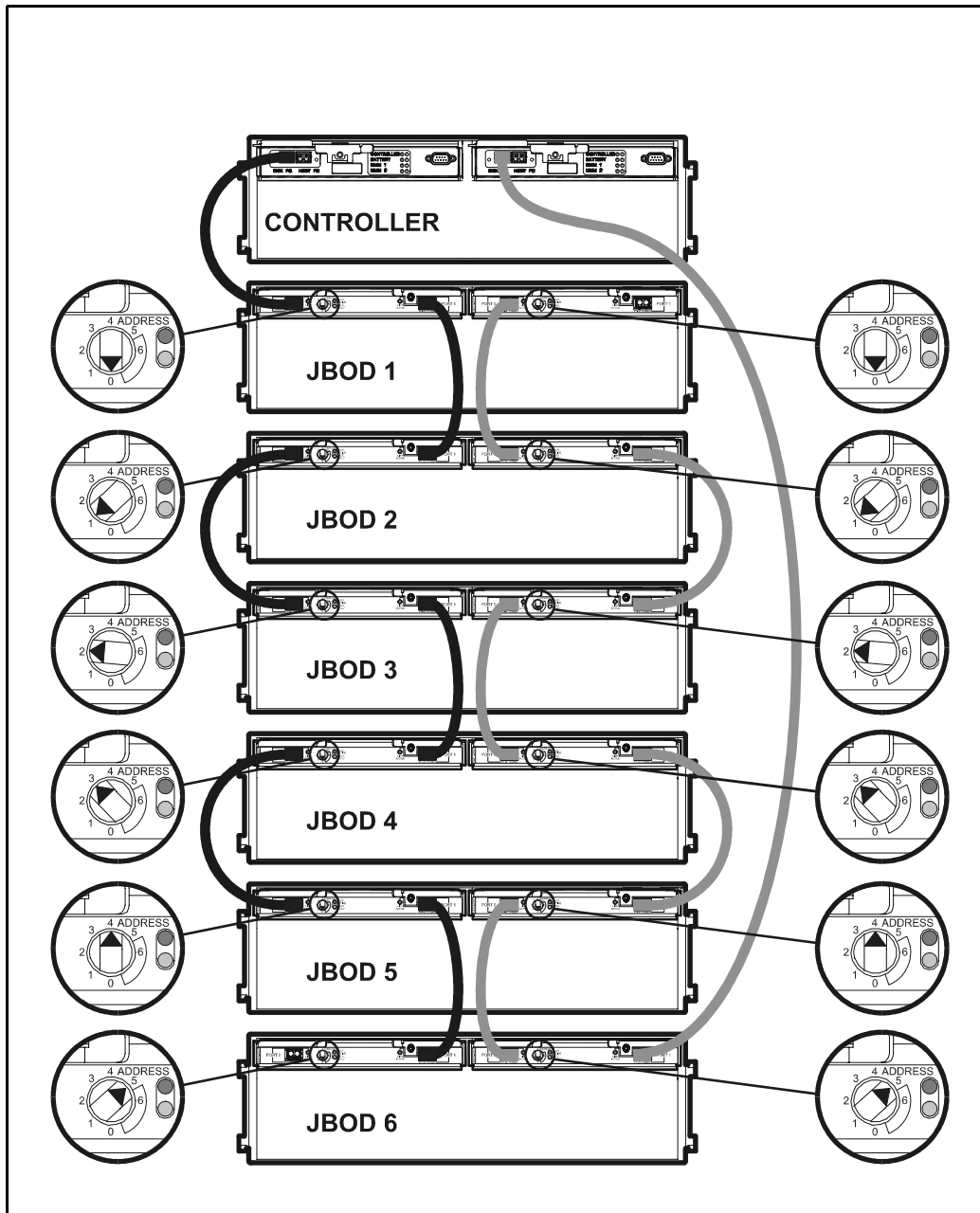


Figure 6 VA 7400 Back-End Fiber Optic Cabling & Addressing (6 JBODs)

Power Modules

The JBOD enclosure is shipped with two fully redundant power modules. Each power module contains:

- an autoranging power supply that converts ac input power to dc output power for use by the other array components. The power supplies share the power load under non-fault conditions. If one power supply fails, the other supply delivers the entire load to maintain power for the array. Each power supply uses a separate power cord. Both power supplies can be plugged into a common power source, or each supply can be plugged into a separate circuit to provide power source redundancy.
- one internal blower, which provides airflow and maintains the proper operating temperature within the array enclosure. If the blower fails, a fault will occur. The other power module will continue to operate and its blower will continue to cool the enclosure. Even if a power supply fails, the blower within the power module will continue to operate; dc power for the blower is distributed from the midplane.

Operating the Power/Standby Switch

When the power/standby switch is in the “power” position, ac power is applied to the primary and secondary sides of the power supplies in the power module and all of the dc circuits in the array are active. When the power/standby switch is in the “standby” position, ac power is only applied to the primary side of the power supplies; all of the dc circuits in the array are disabled.

To switch power on: push in the power/standby switch to the “power” position (see Figure 7).

To switch power to standby: push in the power/standby switch then release it to the “standby” position.

CAUTION: If it is necessary to completely remove power from the array, you must unplug both power cords from the ac power connectors on the array rear panel.

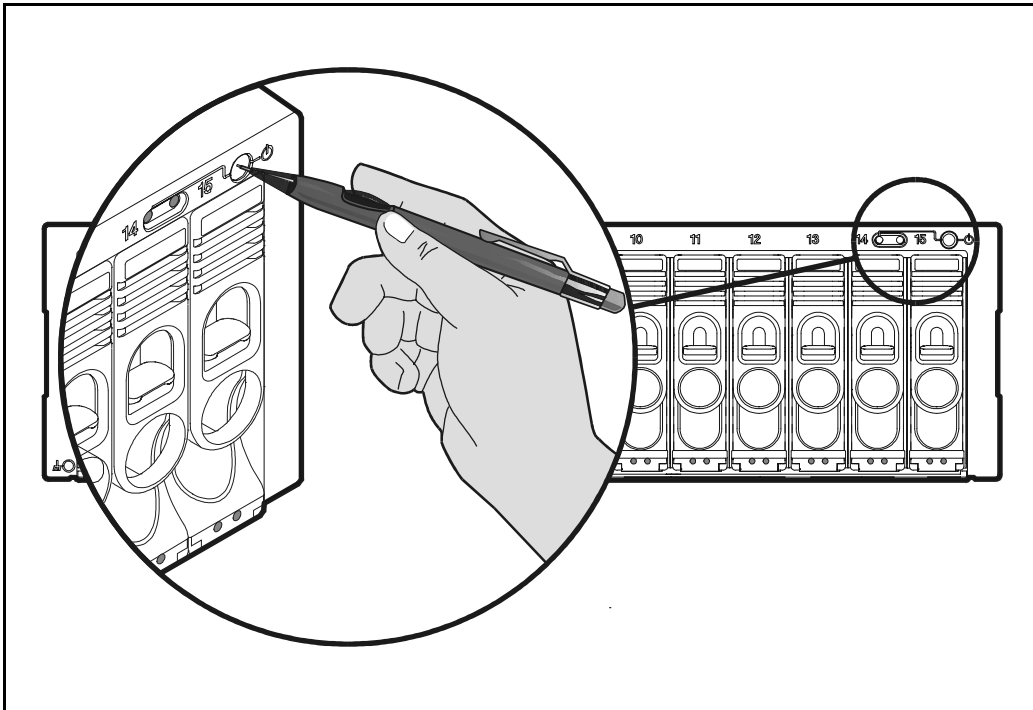


Figure 7 Operating the Power/Standby Switch

Power-On Self-Test

Immediately after the array is powered on, the controller enclosure (VA 7100 and VA 7400) and JBOD enclosures (VA 7400 only) perform a power-on self-test.

During a power-on self-test, you will see the following front panel activity:

- The system power/activity LED turns on solid green.
- The disk drive activity LEDs flash while the controller establishes communication with the drives, then two LEDs at a time turn on solid green, one from the lower disk drive slots (1-8) and one from the upper disk drive slots (9-15), while the associated drives spin up.

NOTE: When the array is powered-on, the battery circuit is enabled and the battery starts supplying power to the DIMMs.

When the power-on self-test completes successfully:

- All LEDs on the front panel should be solid green.

Shutdown

A coordinated process, called “Shutdown”, is used to take the array offline. The primary function of Shutdown is to copy the contents of the controller cache to the image disks. This protects the array against data loss if a battery fails in the absence of ac power. In the Shutdown state, the array can still execute some commands from the host, but the host cannot access any of the data in the array.

A Shutdown is automatically initiated in two ways:

- by moving the power/standby switch to the standby position.
- through array management software.

NOTE: Using software to perform a Shutdown is the preferred method because confirmation of a successful Shutdown is reported to the operator.

If the power fails or if you unplug the power cords without performing a Shutdown, the following sequence will occur when the array is powered on again:

1. The array will attempt to retrieve the maps from cache and determine if they are valid.
2. If the maps are not valid, the array will retrieve the maps from the image disks.

NOTE: If power to the array is lost by any means other than by moving the power/standby switch to the standby position, the array will not have time to perform a successful Shutdown. In this case, a fully charged battery can sustain NVSDRAM contents for 3 days.

Data Storage Process

Virtual Array

The term “Virtual Array” refers to the way the disks within the array are treated as a pool of data storage blocks instead of real physical disks. HP *AutoRAID* technology uses powerful mapping techniques to present the host with a logical view of the available storage in the array (see Figure 8).

Because data is spread across all of the disks in the array, logical-to-physical data maps, stored in array controller cache memory, keep track of where the data is physically located on the disks in the array. The host has no visibility of the cache data maps; it is simply presented with logical units (LUNs) for data storage operations. The VA 7100 can have up to 128 LUNs; the VA 7400 can have up to 1024 LUNs.

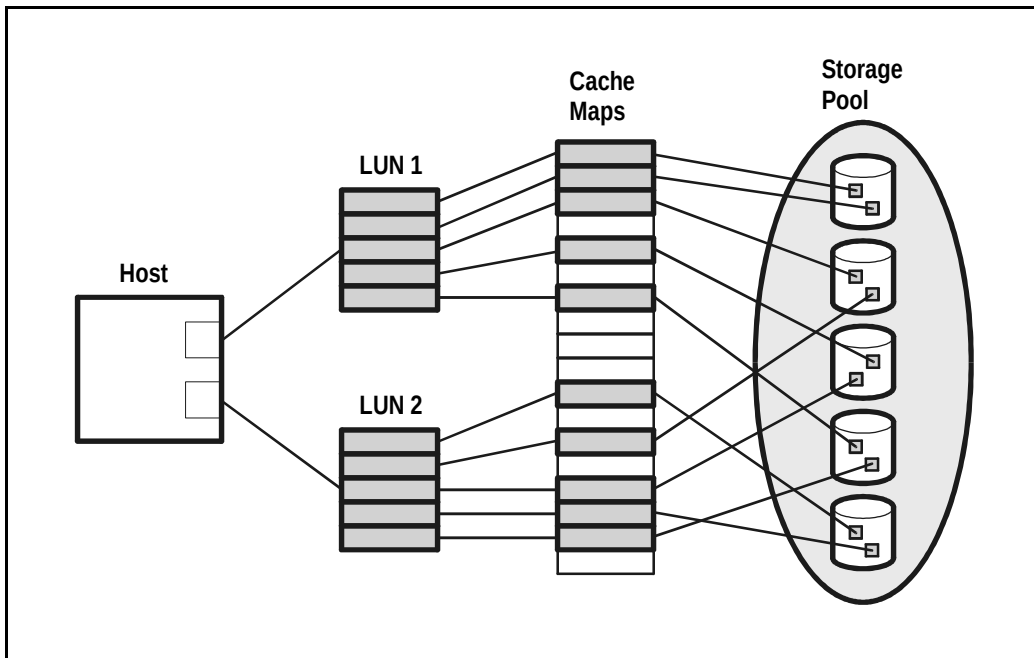


Figure 8 Virtual Data Storage

Redundancy Groups & Data Paths

A “redundancy group” is a group of physical disks that contain redundant data, as defined by the RAID level assigned to the data. A redundancy group is also divided into logical units (LUNs), addressable by the host. The VA 7100 and VA 7400 differ in their implementation of redundancy groups.

VA 7100 Redundancy Group

The VA 7100 has only one redundancy group (see Figure 9). All 15 of the disk drives (D1-D15) in the main (M) controller enclosure are accessible by both Controller 1 (C1) and Controller 2 (C2), with no physical restrictions.

C1 has access to each dual-ported Fibre Channel (FC) disk via Port 1 on FC Loop 1; C2 has access to each disk via Port 2 on FC Loop 2. These two Fibre Channel loops include two lines for the transfer of data to and from controllers: a transmit (Tx) line and a receive (Rx) line. C1 and C2 are connected via an internal (N-way) bus, used for controller-controller communication and loop failover.

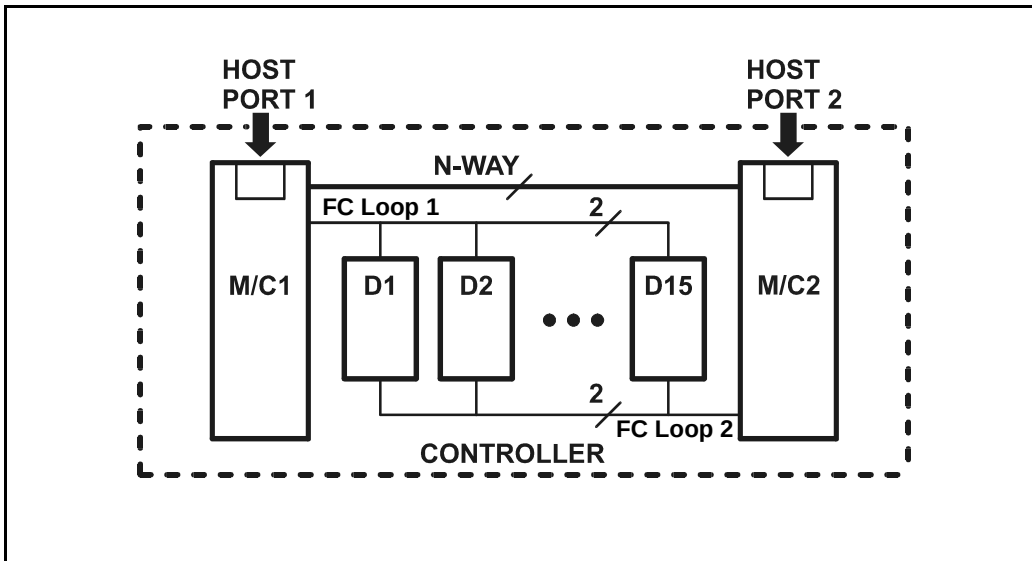


Figure 9 VA 7100 Data Path (One Redundancy Group)

VA 7400 Redundancy Groups

The VA 7400 has two redundancy groups (see Figure 10):

- Controller 1 (C1) controls access to Redundancy Group 1 (RG1), which consists of all of the disk drives in odd numbered slots (D1, D3, D5, D7, D9, D11, D13, D15) in the main (M) controller enclosure, and in all of the connected JBOD enclosures (JA1-JA6).
- Controller 2 (C2) controls access to Redundancy Group 2 (RG2), which consists of all of the disk drives in even numbered slots (D2, D4, D6, D8, D10, D12, D14) in the main (M) controller enclosure, and in all of the connected JBOD enclosures (JA1-JA6).

C1 has access to each dual-ported Fibre Channel (FC) disk via Port 1 on FC Loop 1; C2 has access to each disk via Port 2 on FC Loop 2. These two Fibre Channel loops include two lines for the transfer of data to and from controllers: a transmit (Tx) line and a receive (Rx) line. C1 and C2 are connected via an internal (N-way) bus, used for controller-controller communication and loop failover.

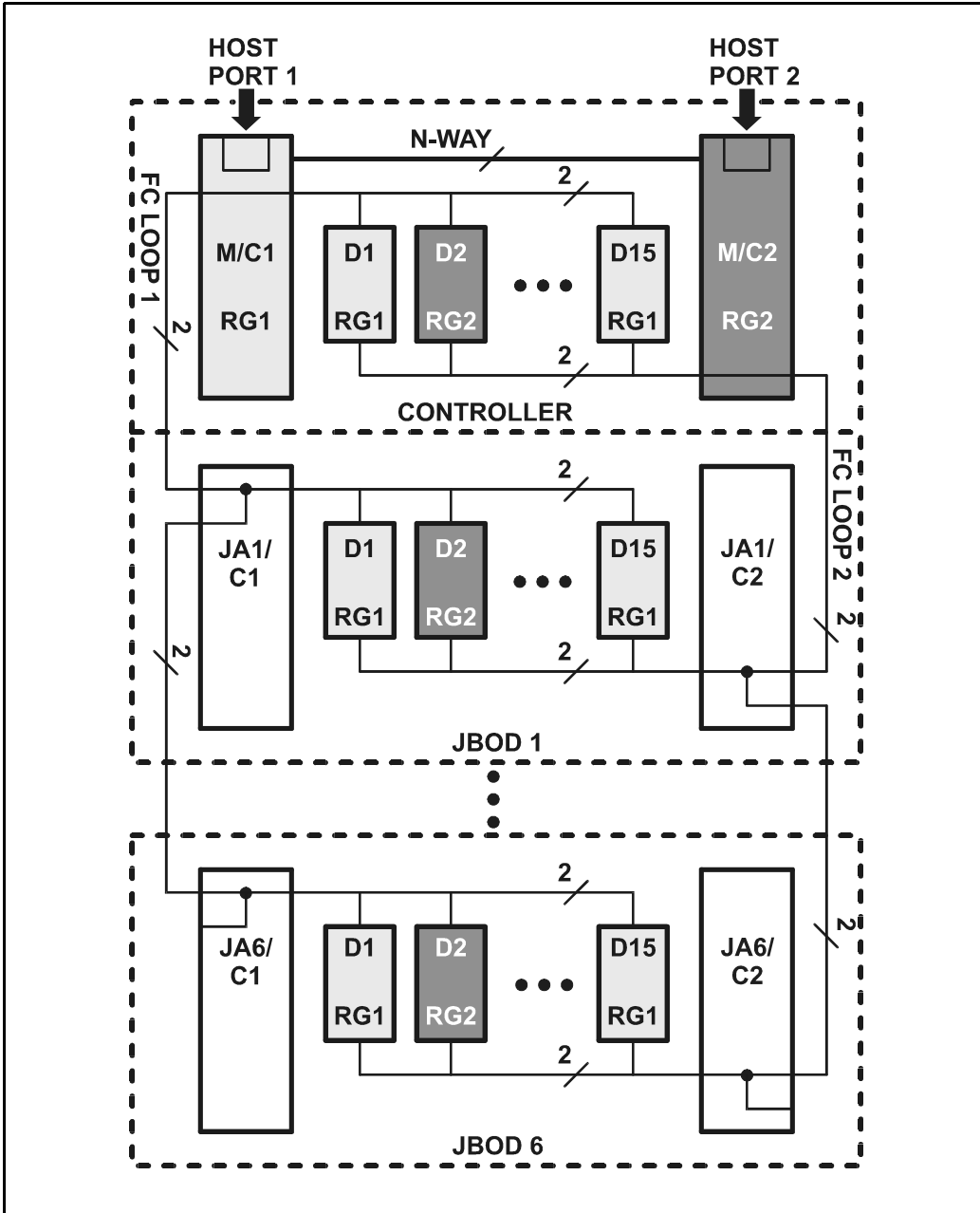


Figure 10 VA 7400 Data Path (Two Redundancy Groups)

Performance Path

The “performance path” is the most direct path the host can take to the data in the array. It is specified by two separate device files that direct the data either through Controller 1 or through Controller 2. The performance path is always the faster path in terms of data transfer rate.

With two array controllers, the host will always have two paths to the data:

- The “primary path” is the most direct path through the primary controller, whose redundancy group owns the logical unit (LUN). In order to access the data, the host simply talks directly to that controller.
- The “secondary path” is the indirect path through the secondary controller. In order to access the data, the host must talk to the secondary controller, which does not own the LUN. The secondary controller then uses the N-way bus to send data to the primary controller, whose redundancy group owns the LUN. Whenever the secondary path is used, there is a performance penalty associated with that operation.

VA 7100 Performance Path

In the VA 7100, the performance path is always specified by the device file for Controller 1. Since the VA 7100 has only one redundancy group, and the secondary controller is used only for failover, the primary controller is always the most direct path to the data. If Controller 1 fails, the host will use the secondary path to Controller 2.

VA 7400 Performance Path

The following example illustrates how the performance path is used in a VA 7400:

Suppose LUN 2 is owned by Redundancy Group 2 under Controller 2. An HP-UX host has two device files that have two separate paths to LUN 2: The primary device file that addresses Controller 2, and the secondary device file that addresses Controller 1. The performance path uses the primary device file, since Controller 2 owns LUN 2. The non-performance path uses the secondary device file. If the secondary device file is used, the data flows through Controller 1, across the N-way bus to Controller 2, and out to LUN 2 and its associated disk drives.

RAID Levels

Redundant Array of Inexpensive Disks (RAID) technology uses different industry-standard techniques for storing data and maintaining data redundancy. These techniques, called “RAID levels”, define the method used for distributing data on the disks in a logical unit (LUN). LUNs that use different RAID levels can be created in the same array. The arrays covered in this guide support the following RAID levels: RAID 1+0 and RAID 5 Double Parity (RAID 5DP).

RAID 1+0

RAID 1+0 provides data redundancy and good performance. However, the performance is achieved by using a less efficient technique of storing redundant data called “mirroring.” Mirroring maintains two sets of the data: a primary set and a backup set, or “mirror”, of the primary set. Therefore, half of the disk space is consumed by redundant data. The data is also striped across the disks in the array.

Figure 11 is an example showing the distribution of primary data and mirror data in a RAID 1+0 configuration. The example shows one LUN with 10 stripes, each stripe with two data segments: n (primary segment) and n' (“n prime” or “mirror” segment). The following data protection scheme is demonstrated for RAID 1+0:

- **If two non-adjacent disks fail, there is no data loss.** Either a primary segment or its mirror segment is still available.
- **If two adjacent disks fail, the data in the entire LUN is lost.** In this example, two segments and their mirrors are lost and cannot be recovered.

NOTE: Disks A and E are considered as adjacent disks. The segment size is some number (x) times 520-byte blocks.

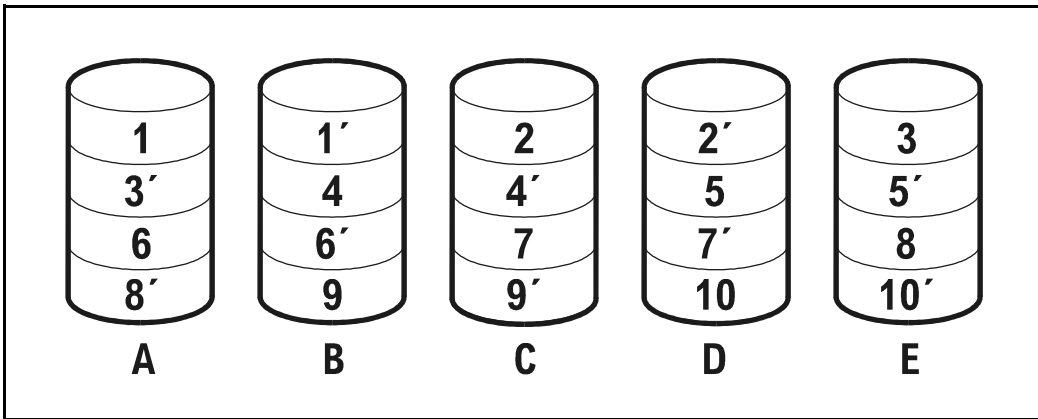


Figure 11 RAID 1+0 Data Storage Example

RAID 5DP

RAID 5DP provides data redundancy and improves cost-efficiency by using a more efficient method of storing redundant data. However, there is a performance penalty for each write operation. This can impact system performance if your applications frequently update large amounts of data. RAID 5DP provides high read throughput for small block-size requests (2 KB to 8 KB) by allowing simultaneous read operations from all of the disks in the LUN.

RAID 5DP uses two independent parity algorithms to create two parity values. The second algorithm provides an additional means to reconstruct data, even if a second disk fails while another disk is being rebuilt. This “double parity” scheme is referred to as “P + Q Parity”.

During a write operation, the array controller calculates “P” and “Q” parity, then distributes (stripes) the data and parity information across the disks in the LUN. The process of calculating and writing parity information affects the write performance of the array.

If a disk fails or becomes inaccessible, the array dynamically reconstructs all user data from the data and parity information on the remaining disks. If another disk fails, with double parity, it can also be recovered even while the first disk is being recovered. When a failed disk is replaced, the array automatically rebuilds the new disk with the data that once resided on the failed disk.

NOTE: Until a failed disk is replaced (or a Rebuild on an active spare is completed), the LUN operates in a degraded state. The LUN must use data and parity information on the remaining disks to recreate the contents of the failed disk, thus reducing performance. Also, if a third disk in the LUN fails while in a degraded state, parity can no longer be used and all data in the LUN becomes inaccessible.

Figure 12 is an example showing the distribution of user data and parity data in a RAID 5DP configuration. The example shows one LUN with five stripes, each stripe with five segments: three data segments and two parity segments (P_n and Q_n). The segments are striped across the disks in a rotating fashion. The following data protection scheme is demonstrated for RAID 5DP:

- **Any one disk can fail without losing data redundancy.** If one disk fails, the data on that disk can be recalculated using either the P or Q parity segment and the data stored on the remaining good segments in the stripe.
- **Any two disks can fail without losing data.** If two disks fail simultaneously (B and C, for example), or if a second disk fails before the first disk is completely rebuilt, the data from both failed disks can be rebuilt. For example, both segments of missing data in stripe 1 on disk B and disk C can be recalculated using the P_1 and Q_1 parity data and the remaining data segment on disk A. Alternatively, if the segment on a lost disk is either P or Q parity data, then the parity data can be recalculated from the remaining user data.

NOTE: Disks A and E are considered as adjacent disks. The segment size is some number (x) times 520-byte blocks.

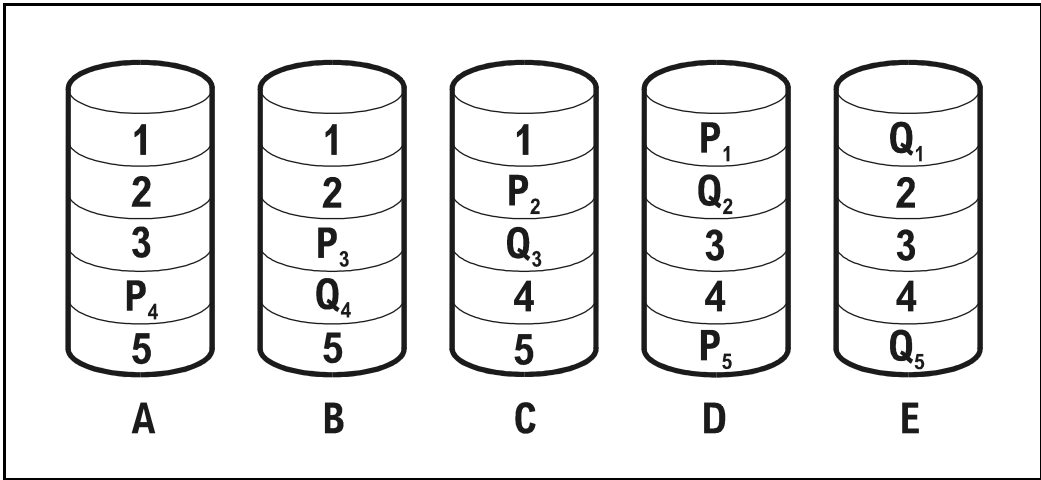


Figure 12 RAID 5DP Data Storage Example

RAID 1+0 & RAID 5DP Combined

Your virtual array uses a combination of RAID 1+0 and RAID 5DP to store data. This means that the same disk within a redundancy group can have one portion of its data capacity stored in RAID 1+0, while the other portion is stored in RAID 5DP. If one disk fails, the array first rebuilds the data in RAID 1+0 (the RAID level most exposed to data loss), then rebuilds the data in RAID 5DP. On the other hand, if two disks fail simultaneously, the array first rebuilds the data in RAID 5DP, then rebuilds the data in RAID 1+0. Thus, your array optimizes the data rebuild process, greatly reducing your exposure to data loss.

Your virtual array will survive two simultaneous disk failures within a redundancy group, without losing data, as long as none of the data segments in the disks are mirrors of each other.

Dynamic Data Migration

Unlike conventional disk arrays, your array manages its data for the optimum balance of performance and storage efficiency by using an innovative technique called “dynamic data migration”. Most arrays operate using a single RAID level at a time. Dynamic data migration uses two levels: RAID 1+0 to optimize performance, and RAID 5DP to optimize storage efficiency. This is achieved by automatically changing the RAID level used as the amount of data stored increases.

End-to-End Checksum

End-to-end checksum is the process used by the array controller to check data during read and write operations. During a write operation, as data enters the array controller from the host, the controller calculates checksum values on the data and appends 8 bytes of checksum information to each 512-byte data sector. The controller then stores the data as a 520-byte sector on the disk drives. This is why the disk drives are formatted with 520-byte sectors. During a read operation, the array controller reads the sectors containing the checksum information from the disk drives. The checksum information is checked by the array controller to ensure the data is valid. The 8 bytes of checksum information is then removed, and the original 512-byte data sector is sent to the host.

2. System Configurations

This chapter shows the following four typical system configurations for the arrays:

- Low-end non-clustered with optional path redundancy (see Figure 13)
- Mid-range non-clustered with optional path redundancy (see Figure 14)
- Mid-range non-clustered with full storage path redundancy (see Figure 15)
- HP-UX or Windows cluster with full path redundancy (see Figure 16)

NOTE: For more information on system configurations for your array, refer to the *Configuration Guide* or consult your HP Sales Representative.

Low-End Non-Clustered with Optional Path Redundancy

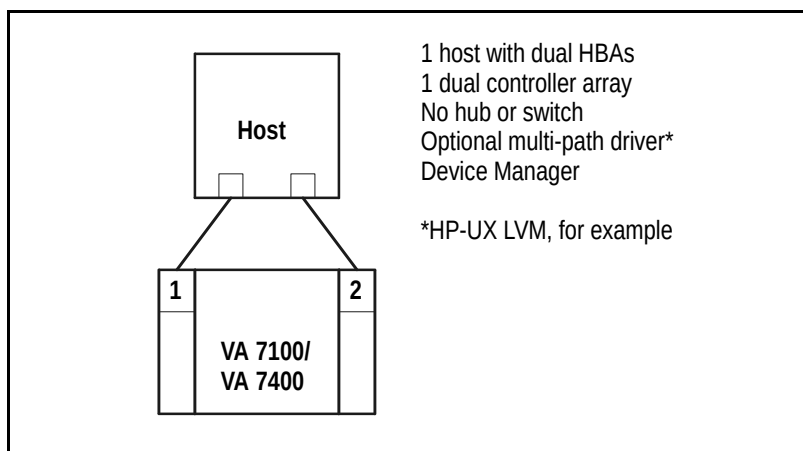


Figure 13 Low-End Non-Clustered with Optional Path Redundancy

Mid-Range Non-Clustered with Optional Path Redundancy

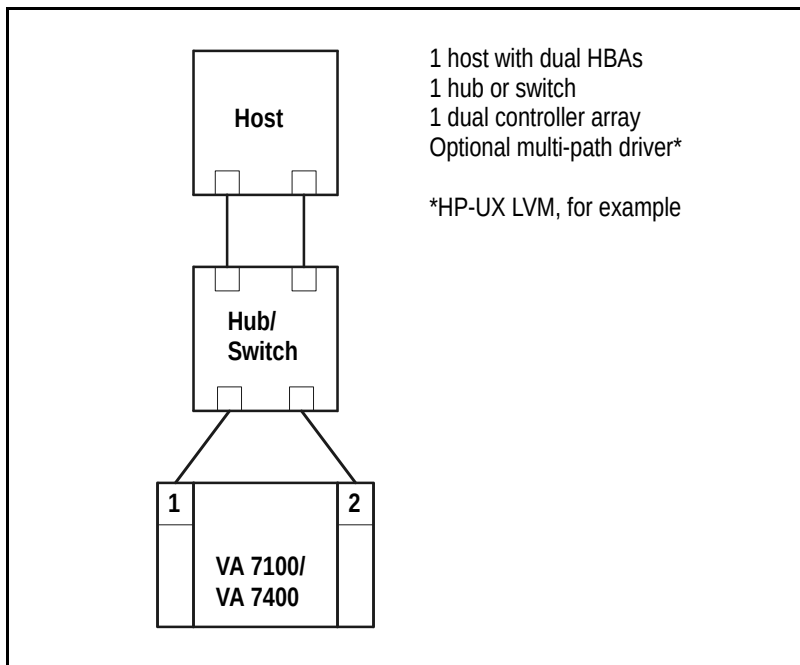


Figure 14 Mid-Range Non-Clustered with Optional Path Redundancy

Mid-Range Non-Clustered with Full Storage Path Redundancy

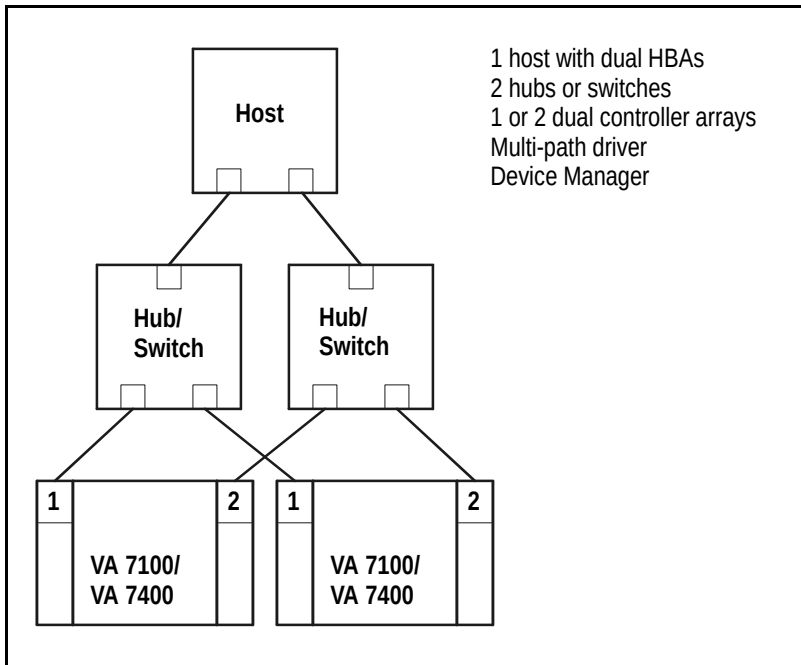


Figure 15 Mid-Range Non-Clustered with Full Storage Path Redundancy

HP-UX or Windows Cluster with Full Path Redundancy

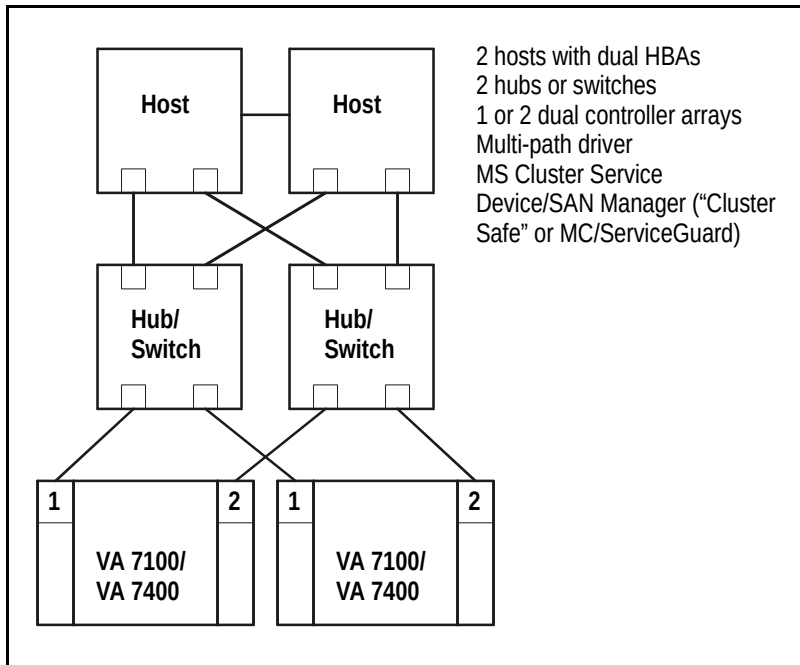


Figure 16 HP-UX or Windows Cluster with Full Path Redundancy

3. Troubleshooting

This chapter describes how to troubleshoot the array if a failure occurs. A failure may be indicated by any of the following:

- array status LEDs
- array management software
- host applications

NOTE: This chapter will only discuss the first two indicators. Refer to your host application documentation for host application failure indications.

Troubleshooting Steps

Follow these basic steps for troubleshooting the array:

1. Check the state of the array and the status of the field replaceable units (FRUs) in the array. (See “Checking Array State & Status” in this chapter.)
2. Check the array controller logs. (See “Checking Controller Logs” in this chapter.)
3. Replace a faulty FRU or repair the array.
4. Verify the array is operational and that no amber fault LEDs, error messages, or Warning states are displayed.

Redundant FRUs

The following FRUs are redundant; if they fail, the array is still available to the host for I/O activity:

- 1 disk drive (per enclosure)
- 1 power module (per enclosure)
- 1 array controller card (controller enclosure)
- 1 link controller card (JBOD enclosure)

CAUTION: The midplane assembly in the controller enclosure and the JBOD enclosure is the only single point of failure for the array. If the array goes down because of a midplane failure, you must repair the array before the battery on the array controller card becomes depleted.

Array State & Status

The “state” of the array is indicated by HP SureStore Command View SDM software with the following state parameters (state messages in parenthesis):

- Array Controller (Controller Mismatch, Mismatched Code, No Code, No Map)
- Disk Drives (Disk Format Mismatch, No Quorum, Not Enough Drives)
- Array Readiness (Ready, Shutdown, Shutdown Warning, Shutting Down, Starting Up)
- Array Warnings (Active Spare Unavailable, Battery Failure, Code Mismatch, Controller Mismatch, Controller Problem, Data Unavailable, Drive Configuration Problem, FRU Monitor Problem, Insufficient Map Disks, Link Down, No Map Disks, NVRAM Battery Depletion, Over Temperature Condition, Physical Drive Problem, Power Supply Failed, Rebuild Failed, State Changing)

The “status” of the array refers to a normal or fault condition for each FRU within the array. Check the state and status of the array using any of the following methods:

- LED status indications
- *HP SureStore Command View SDM* interfaces - Command View Graphical User Interface (CVGUI), Command Line User Interface (CLUI), or Command View User Interface (CVUI)
- Virtual Front Panel (VFP)

NOTE: If the array fails before it has successfully communicated with the host, use the VFP to start troubleshooting steps. If the array fails after it has successfully communicated with the host, use one of the *HP SureStore Command View SDM* interfaces to discover the state and status of the array.

Link Down Warning State

NOTE: A “link” consists of two unidirectional fibres, transmitting in opposite directions, and their associated transmitters and receivers which communicate between nodes in a Fibre Channel-Arbitrated Loop.

A “Link Down” warning state can be reported by the CVGUI if either of the following two failures occur:

- If a host Fibre Channel loop fails due to the failure of a host HBA, a faulty or disconnected fibre channel cable, a faulty GBIC (VA 7100 only), or the failure of a data flow component on an array controller.
- If an array Fibre Channel loop fails due to a port failure on a disk drive, faulty loop circuitry on the midplane, or the failure of a data flow component on an array controller. If a port failure occurs, a port bypass circuit will bypass that part of the loop and the first array controller will re-route the data through the second array controller, via the internal N-way bus, to the other Fibre Channel loop.

Array Power-On Sequence

Table 6 shows the power-on sequence for the array. This sequence can be viewed via the Virtual Front Panel (VFP) when the array is powered on.

Table 6 Array Power-On Sequence

Step No. (Hex)	Description of Array Operation
02	Power-on self-test complete.
04	Check array serial number. Configure NVRAM for maps. Initialize all NVRAM on both controllers.
06	Initialize internals.
08	Initialize array scheduler.
0A	Search for backend devices.
0C	Backend device discovery complete.
0E	Enable power supply manager to shutdown if needed.
12	Initialize maps and cache via upload from image disks. Attach array to volume set.
16	Enable hot plugging.
18	Enable warning services.
1A	Reserved.
1C	Setup internal data structures based on backend discovery.
1D	Enable frontend ports.
1E	Initialize array clocks.
20	Setup internal data structures.
22	Synchronize both controller clocks.
24	Startup complete. Enable scheduler. Allow writes to disks.
26	Initialization complete.

LED Status Indications

NOTE: If a component fails in an enclosure, the fault will be indicated by at least two amber fault LEDs. For example, if a disk drive fails, the system fault LED will light and the disk drive fault LED will light.

Table 7 through Table 17 describe the LED status indications for the array front and rear panel LEDs shown in Figure 17 through Figure 22.

System LEDs

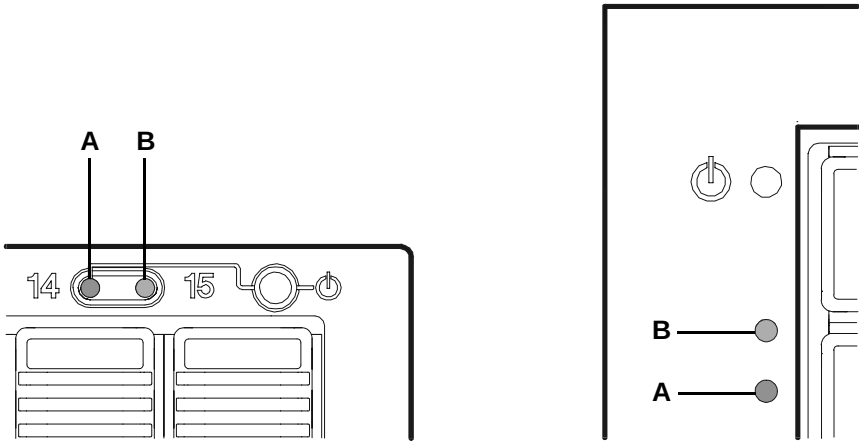


Figure 17 System LEDs (Left: VA 71/7400 A/AZ; Right: VA 7100 D)

Table 7 System LEDs Status Indications (See Figure 17)

A System Power/ Activity (Green)	Indication
Off*	ANDed with Amber On or Amber Flashing or enclosure not under power.
On	Enclosure under power; no I/O activity.
Flashing*	I/O activity.
B System Fault (Amber)	Indication
Off	Enclosure not under power or no active warning.
On**	Warning active (FRU fault).
Flashing**	Host is identifying a FRU.

*States can occur simultaneously with Amber(**) states.

**States can occur simultaneously with Green(*) states.

Disk Drive LEDs

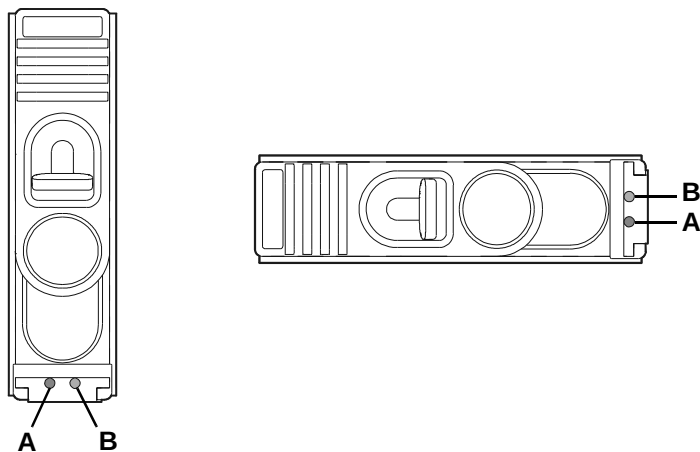


Figure 18 Disk Drive LEDs (Left: VA 71/7400 A/AZ; Right: VA 7100 D)

Table 8 Disk Drive LEDs Status Indications (See Figure 18)

A Disk Activity (Green*)	B Disk Fault (Amber**)	Indication
Off	Off	Disk not under power.
On	Off	Disk drive under power and operating normally.
Off	On	Disk drive fault.
On	On	Disk drive fault.
Flashing	Off	Disk drive self-test in progress or I/O activity.
On/Off	Flashing	Host is identifying disk drive.

*Controlled by the disk drive.

**Controlled by the array controller.

NOTE:

- In a controller enclosure, the amber disk fault LED will flash during an Auto Format process. On a JBOD enclosure, the amber system fault LED will also flash because the amber disk LED and amber system LED are ORed together.
- In a controller enclosure, the amber disk fault LED will flash while downing a disk drive. On a JBOD enclosure, the amber system fault LED will also flash because the amber disk LED and amber system LED are ORed together.

Array Controller LEDs

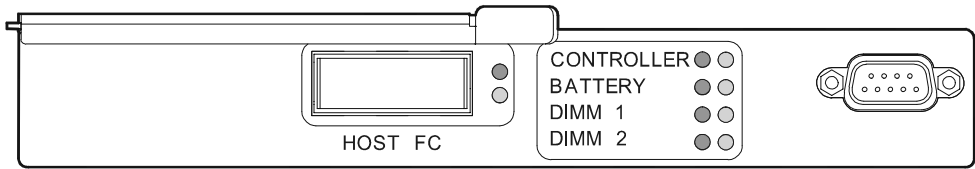


Figure 19 Type A Array Controller LEDs (VA 7100 A/AZ/D)

Table 9 HOST FC LEDs Status Indications (See Figure 19)

HOST FC GBIC Active (Green)	HOST FC GBIC Fault (Amber)	Indication
Off	Off	GBIC not under power or link down or GBIC not installed.
On	Off	GBIC installed and operating normally.
Off	On	GBIC fault; GBIC not able to generate Transmit signal.
Off	Flashing	GBIC fault; GBIC has lost Receive signal.

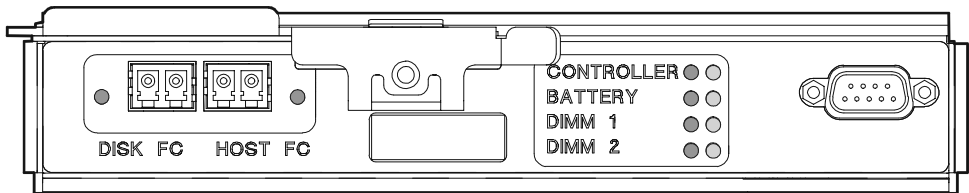


Figure 20 Type B Array Controller LEDs (VA 7400 A/AZ)

Table 10 DISK FC LED Status Indications (See Figure 20)

DISK FC (Green)	Indication
Off	Unit not under power or JBOD (backend) FC link down.
On	Valid Fibre Channel link to JBOD enclosure.

Table 11 HOST FC LED Status Indications (See Figure 20)

HOST FC (Green)	Indication
Off	Unit not under power or host (frontend) FC link down.
On	Valid Fibre Channel link to host.

Table 12 CONTROLLER LEDs Status Indications (See Figure 19 & Figure 20)

CONTROLLER Active (Green)	CONTROLLER Fault (Amber)	Indication
Off	Off	Array controller not under power.
On	Off	Array controller under power and operating normally.
*	On	Array controller fault.
Flashing	*	I/O activity.
*	Flashing	Host identifying array controller.

*Can be on, off, or flashing

Table 13 BATTERY LEDs Status Indications (See Figure 19 & Figure 20)

BATTERY Active (Green)	BATTERY Fault (Amber)	Indication
Off	Off	New battery <i>or</i> battery totally depleted.
On	Off	Battery under power and operating normally.
On	On	Battery failed <i>or</i> battery has reached end of usable life.
Flashing 50% Duty Cycle	Off	Battery self-test in progress.
Flashing 5% Duty Cycle	Off	Battery is powering NVSDRAM contents.

Table 14 DIMM 1 & DIMM 2 LEDs Status Indications (See Figure 19 & Figure 20)

DIMM 1/ DIMM 2 Active (Green)	DIMM 1/ DIMM 2 Fault (Amber)	Indication
Off	Off	DIMM not under power <i>or</i> DIMM not installed.
On	Off	DIMM under power and operating normally.
Off	On	DIMM fault.

Link Controller LEDs

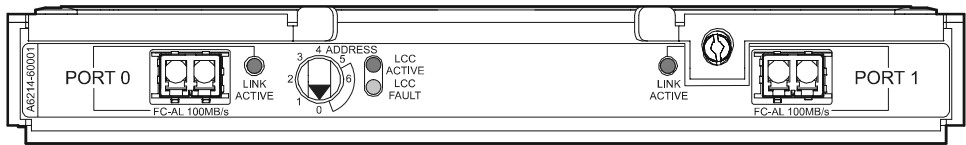


Figure 21 LCC LEDs (VA 7400 A/AZ)

Table 15 LCC ACTIVE & LCC FAULT LEDs Status Indications (See Figure 21)

LCC ACTIVE (Green)	LCC FAULT (Amber)	Indication
Off	Off	LCC not under power.
On	Off	LCC under power and operating normally.
Off	On	LCC fault.
Flashing	Off	LCC self-test in progress.

Table 16 PORT 0 & PORT 1 LINK ACTIVE LEDs Status Indications (See Figure 21)

PORT 0/ PORT 1 LINK ACTIVE (Green)	Indication
Off	LCC not under power or Fibre Channel link not active.
On	Fibre Channel link active.

Power Module LEDs

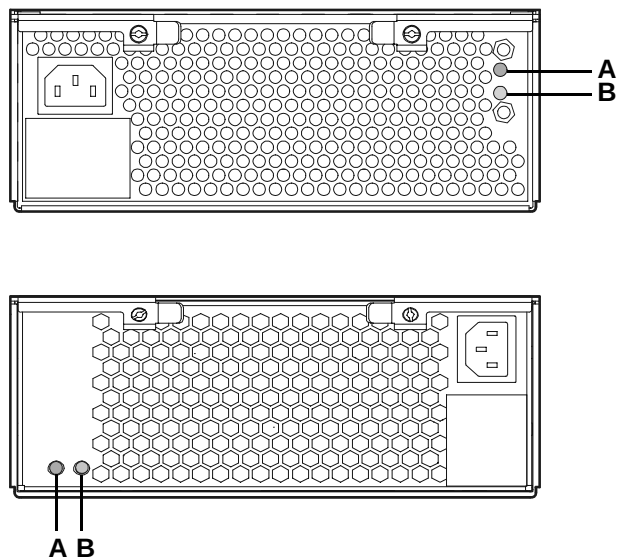


Figure 22 Power Module LEDs (Upper: Controller Enclosure; Lower: JBOD Enclosure)

Table 17 Power Module LEDs Status Indications (See Figure 22)

A Power On LED (Green)	B Power Fault LED (Amber)	Indication
Off	Off	Power module not under power.
On	Off	Power module under power and operating normally.
Off	On	Power module fault.
On	On	Power module fault (rare indication).
*	Flashing	Host identifying power module.

*Can be on, off, or flashing

State & Status with CVGUI

1. The array state is displayed with an icon in the upper left-hand corner (banner area) of the screen.
2. Click on the “Status” tab. Click on “Array Status” and view the “Overall Array State” and “Warning States”. Click the Help button for a description of the problem and solution for “Warning States”. Click on “Component Status” then click on a component in the “Selected Enclosure” box on the left-hand side to display the status of any array component. Click the Help button for a description of the status for each component.
3. Click on the “Diagnostics” tab. Click on “Array” to display the same information as “Array Status” under the “Status” tab. Click on “Disk” then click on “Condition” to display the status of the disks in the array. Click on “State” to see if the disks are currently included or not included.

State & Status with CLUI

1. Use the “armdsp -a” command to display the Array State messages and detailed information about the FRUs in the array.
2. Use the “armdsp -f” command to quickly display any FRU Status messages.

State & Status with CVUI

1. Select “Storage->HpArrayMain->Properties->Config&Status” to display the Array State messages and detailed information about the FRUs in the array.
2. Select “Storage->HpArrayMain->Properties->Components” to quickly display any FRU Status messages.

State & Status with VFP

1. Use the “vfpdsp” command to display the Array State messages and detailed information about the FRUs in the array.
2. Use the “vfpdsp -f” command to quickly display any FRU Status messages.

Array Controller Logs

Types of Array Controller Logs

There are three types of array controller log entries:

- **Controller logs.** Controller logs contain events relating to the operation of all FRUs in the array, obtained from the controller during the operation of the array. The HP SureStore Command View SDM logging routine polls the array every 15 minutes to retrieve and store the log entries in special Controller log files. Each log entry has a decimal event number and an event name. A list of the “Controller Log Event Code Descriptions” is available at:
www.hp.com/support/va7100

NOTE: A controller log entry is made every 6 months when the controller battery performs a self-test and a deep discharge.

- **Usage logs.** Entries for the Usage log are generated from the output of the `armdsp` command. The HP SureStore Command View SDM logging routine runs the “`armdsp -a`” command and stores its output as entries in the Usage log file. This occurs every 24 hours by default, but can be changed to a setting from 1 to 100 hours.
- **Software logs.** Using the “`sanlog`” utility, the output of any CLUI command can be stored as a log entry. The “`sanlog`” command must be initiated by the user.

Location of Array Controller Logs

Array controller logs are stored in three locations:

- **NVSDRAM.** 256 kilobytes of NVSDRAM memory is reserved to hold one thousand log entries.
- **Image Disks.** The logs in NVSDRAM are mirrored and backed up by the image disks.
- **Host OS directory.** polls the controller every 10 minutes and updates the following host directory, located on the host internal disk:
`<command view home dir>/sanmgr/cmdview/server/logs`

Checking Array Controller Logs

Check the array controller logs using one of the following methods:

- **HP SureStore Command View SDM - Command Line User Interface (CLUI).** Refer to the “armlog” command in the *HP Command View SDM Installation & User Guide*.
- **HP SureStore Command View SDM - Command View User Interface (CVUI).** Refer to this menu in the *HP Command View SDM Installation & User Guide*:
“Storage->HpArrayMain->Diagnostics->ArrayLogs”

EMS Hardware Monitors (HP-UX Only)

With Event Monitoring Service (EMS) monitors, you can be alerted to problems as they occur, allowing you to respond quickly to correct a problem before it impacts the operation of the array. All components and aspects of the array are monitored. EMS gives you the flexibility to deliver event notification using a variety of methods.

- More information on EMS Hardware Monitoring can be found at the Systems, Hardware, Diagnostics, and Monitoring section of HP’s Online Documentation Web site at:
www.docs.hp.com/hpux/diag/
- The “EMS Events List” is available at:
www.hp.com/support/va7100

EMS Event Severity Levels

Each event detected and reported by the EMS monitor is assigned a severity level, which indicates the impact the event may have on the operation of the array. The following severity levels are used for all events:

- **Critical** - An event that causes host system downtime, or other loss of service. Host system operation will be affected if the disk system continues to be used without correction of the problem. Immediate action is required.
- **Serious** - An event that may cause, host system downtime, or other loss of service if left uncorrected. Host system and hardware operation may be adversely affected. The problem needs repair as soon as possible.
- **Major Warning** - An event that could escalate to a serious condition if not corrected. Host system operation should not be affected and normal use of the disk system can continue. Repair is needed but at a convenient time.
- **Minor Warning** - An event that will not likely escalate to a severe condition if left uncorrected. Host system operation will not be interrupted and normal use of the disk system can continue. The problem can be repaired at a convenient time.
- **Information** - An event that is expected as part of the normal operation of the hardware. No action is required.

EMS Event Message

An EMS event message typically includes the following information:

- **Message Data** - Date and time the message was sent, the source and destination of the message, and the severity level.
- **Event Data** - Date and time of the event, the host, event ID, name of the monitor, event number, event class, severity level, hardware path, and associated OS error log entry ID.
- **Error Description** - Information indicating the component that experienced the event and the nature of the event.
- **Probable Cause/Recommended Action** - The cause of the event and suggested steps toward a solution. This information should be the first step in troubleshooting the array.

4. Servicing & Upgrading

This chapter includes removal and replacement procedures for the field replaceable units (FRUs) listed in Table 18. It also includes array upgrade procedures.

Field Replaceable Units (FRUs)

Identifying FRUs

There are two types of field replaceable units:

- **“HP Service Personnel Only”.** These units that can be serviced *only* by HP service personnel, or by qualified service representatives. They are designated as “HP” in Table 18 and Table 19.
- **“Customer Replaceable Units”.** These units can be serviced by a customer, or by HP service personnel or qualified service representatives. (A “customer” is defined as any person responsible for the administration, operation, or management of the array.) They are designated as “CRU” in Table 18 and Table 19.

NOTE: The FRU type designations also apply to upgrade kits. For example, only HP service personnel should install an upgrade array controller, but a customer may install an upgrade disk drive to increase capacity.

Refer to the following figures and tables to identify FRUs in the controller enclosure and the JBOD enclosure:

- Figure 23 shows the locations of the controller enclosure FRUs and Table 18 lists their part numbers.
- Figure 24 shows the locations of the JBOD enclosure FRUs and Table 19 lists their part numbers.

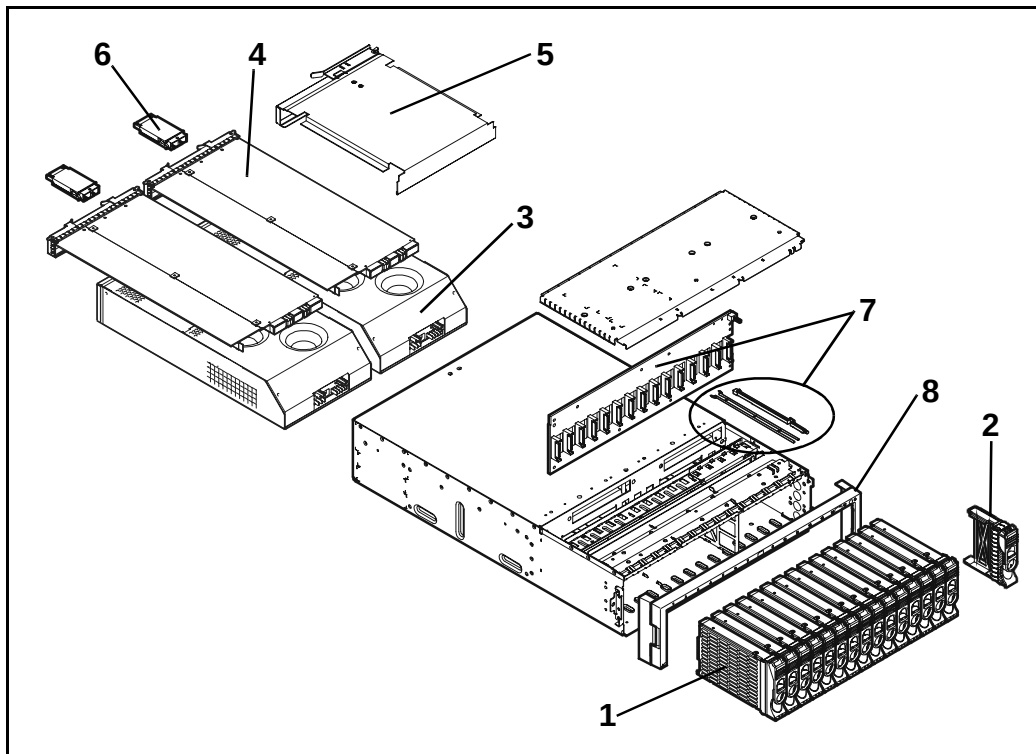


Figure 23 Controller Enclosure FRUs (VA 7100 & VA 7400)

Table 18 Controller Enclosure Field Replaceable Units (VA 7100 & 7400)

Fig. 23 Item	Part No.	FRU Description	Qty Per Encl.	Exch./ Repl. Part	FRU Type
1	A6191-69001	Disk Drive, 18GB, 15k rpm, 512 bytes/sector	4-15* 10-15**	E	CRU
1	A6192-69001	Disk Drive, 36GB, 10k rpm, 512 bytes/sector	4-15* 10-15**	E	CRU
1	A6194-69001	Disk Drive, 73GB, 10k rpm, 512 bytes/sector	4-15* 10-15**		
2	A6198-67001	Disk Filler Panel	0-11* 0-5**	R	CRU
3	A6211-69001	Power Module	2	E	CRU
4	A6188-69001	Array Controller Card (also referred to as Virtual Array Processor, includes battery)	1 or 2	E	HP
REF	A6185-67001	256MB DIMM (used on item 4)	1 or 2***	R	HP
REF	A6186-67001	512MB DIMM (used on item 4)	1 or 2***	R	HP
REF	A6187-67001	1024MB DIMM (2 x 512MB DIMMs, used on item 4)	1***	R	HP
REF	A6188-67002	Battery Kit (includes: Li-Ion battery & battery clamp; used on item 4)	1***	R	CRU
5	A6197-67001	Array Controller Filler Panel	0 or 1	R	CRU
6	A6203-67001	GBIC, optical shortwave	1***	R	CRU
7	A6183-67005	Midplane Assembly (includes: midplane PCA, T-15 driver, ESD kit, 9 x T-15 x 6/32 x 7/16" long screws, 3 x T-10 x 6mm long screws, 2 x power/ standby switch shaft, 2 x lightpipe)	1	R	HP
8	A6183-67001	Enclosure Bezel	1	R	CRU

*VA 7100

**VA 7400

***Per controller

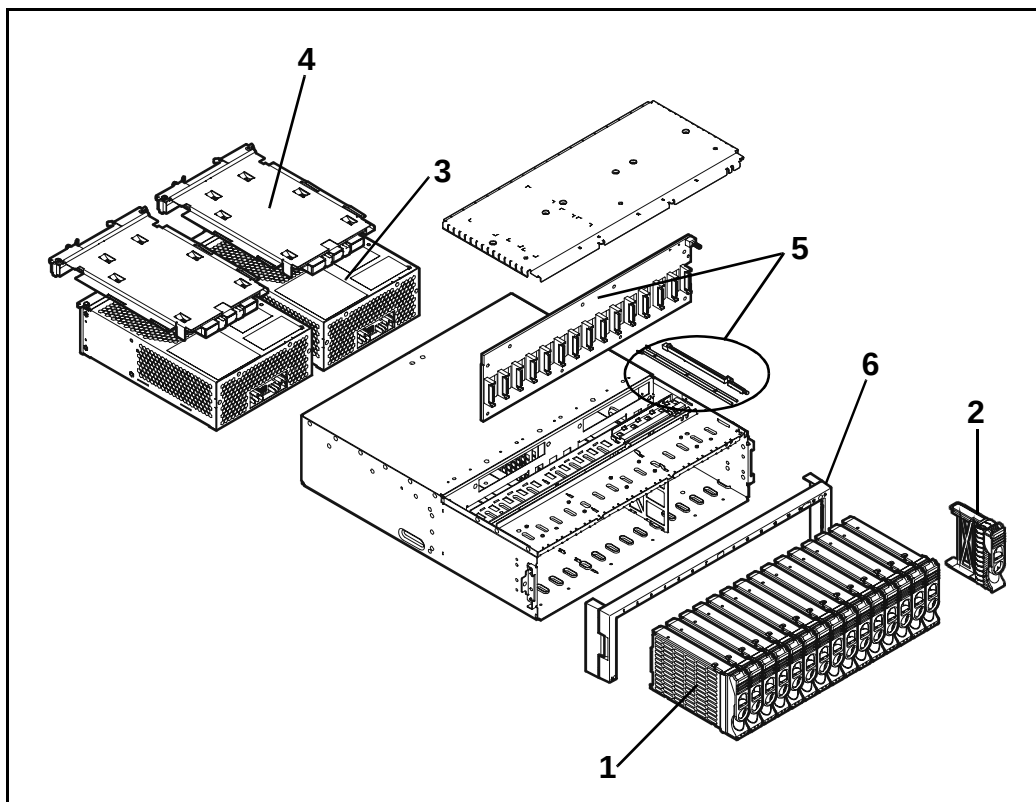


Figure 24 JBOD Enclosure FRUs (VA 7400 Only)

Table 19 JBOD Enclosure Field Replaceable Units (VA 7400 Only)

Fig. 24 Item	Part No.	FRU Description	Qty Per Encl.	Exch./ Repl. Part	FRU Type
1	A6191-69001	Disk Drive, 18GB, 15k rpm, 512 bytes/sector	4-15* 10-15**	E	CRU
1	A6192-69001	Disk Drive, 36GB, 10k rpm, 512 bytes/sector	4-15* 10-15**	E	CRU
1	A6194-69001	Disk Drive, 73GB, 10k rpm, 512 bytes/sector	4-15* 10-15**		
2	A6198-67001	Disk Drive Filler Panel	0-11* 0-5**	R	CRU
3	A6250-69001	Power Module	2	E	CRU
4	A6214-69001	Link Controller Card	2	E	HP
5	A6250-67005	Midplane Assembly (includes: midplane PCA, T-15 driver, ESD kit, 9 x T-15 x 6/32 x 7/16" long screws, 3 x T-10 x 6mm long screws, 2 x power/ standby switch shaft, 2 x lightpipe)	1	R	HP
6	A6214-67003	Enclosure Bezel	1	R	CRU

*VA 7100

**VA 7400

Table 20 Reference Parts

Part No.	Description
A3231-60030	Rack Rail Kit, HP Computer Cabinet
A6209-60001	Rack Rail Kit, HP Rack System/E
A5635-60001	Rack Rail Kit, Compaq 9000
24540-80014	RS-232 Cable, 9-pin-9-pin, DB9, Null Modem
A3583A	2m SC-SC M/M Fiber Optic Cable
A3531A	16m SC-SC M/M Fiber Optic Cable
A3735A	50m SC-SC M/M Fiber Optic Cable
A3736A	100m SC-SC M/M Fiber Optic Cable
C7524A	2m LC-LC M/M Fiber Optic Cable
C7525A	16m LC-LC M/M Fiber Optic Cable
C7526A	50m LC-LC M/M Fiber Optic Cable
C7527A	100m LC-LC M/M Fiber Optic Cable
C7529A	2m LC-SC M/M Fiber Optic Adapter Cable
C7530A	16m LC-SC M/M Fiber Optic Adapter Cable
C7534A	F/F Fiber Optic Coupler

Hot Swappable FRUs

A field replaceable unit (FRU) is “hot swappable” if it can be removed and replaced while the array is powered on, without disrupting I/O activity. A FRU is *not* hot swappable if all applications and file systems must be terminated, or a host shutdown must be performed, before it can be replaced. Table 21 shows hot swappable FRUs for the controller enclosure and the JBOD enclosure.

Table 21 Hot Swappable FRUs

Enclosures	FRU	Hot Swappable?
Controller & JBOD	Disk Drive	Yes
Controller & JBOD	Power Module	Yes
Controller	Single Controller	No
Controller	Dual Controller	Yes*
Controller (VA 7100 Only)	GBIC	Yes*
Controller & JBOD	Fiber Optic Cables	Yes*
JBOD	Link Controller Card	Yes
Controller & JBOD	Midplane Assembly	No

*Only if the OS supports controller failover.

Controller Enclosure Removal & Replacement Procedures

Disk Drives

NOTE: The same disk drives are used in both the controller enclosure and the JBOD enclosure.

Removing a Disk Drive

CAUTION: Do not operate the array for more than 5 minutes with a disk drive or filler panel removed. Either a disk drive or filler panel must be installed in the slot to maintain proper airflow.

1. Push down the release tab (Figure 25, A) and pull up the cam lever (1).

CAUTION: Wait 15 seconds for the disk drive to stop spinning before fully removing it from the array enclosure. Removing a disk drive while it is spinning may cause damage to the disk spindle bearings.

2. Pull the disk drive (2) out of the slot.

Replacing a Disk Drive

1. Push down the release tab (Figure 25, A) and pull up the cam lever (1).
2. Push the disk drive (2) firmly into the slot.
3. Push down the cam lever until it clicks into place to secure the disk drive.

NOTE: An exchange disk drive comes formatted with 512-byte sectors. After installation, the controller starts the Auto Format process to automatically format the disk drive with 520-byte sectors. This process may take 30 to 60 minutes to complete, depending on disk drive capacity and system availability. During this time, the green disk activity LED will be flashing.

CAUTION: To prevent corruption of the disk format, do not remove a newly installed disk drive or power-off the array during the Auto Format process. If a disk is removed during an Auto Format, the array will automatically re-start the Auto Format process from the beginning.

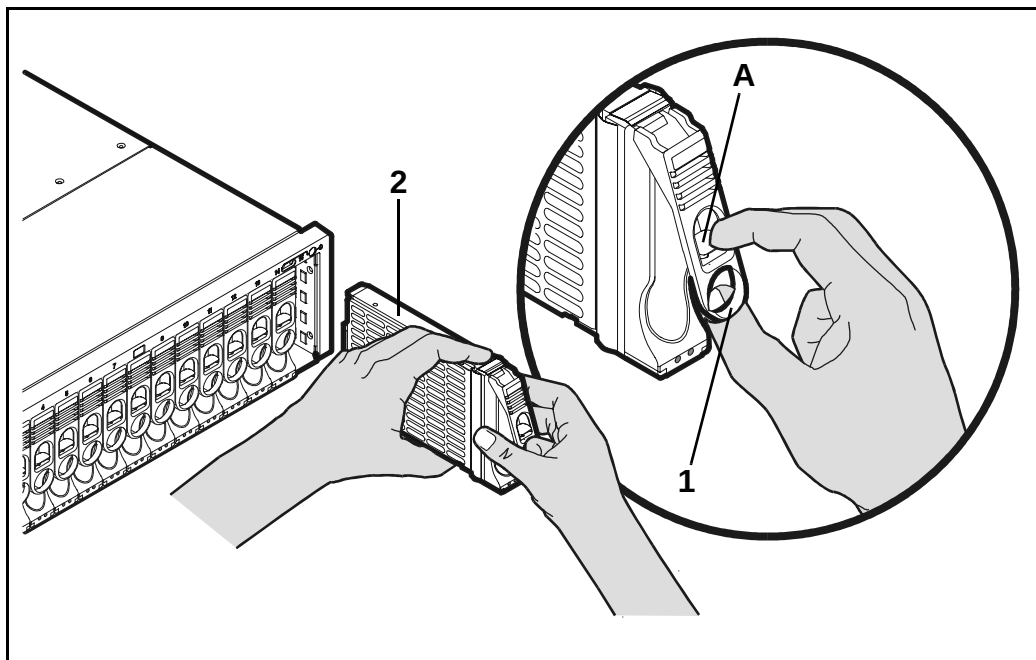


Figure 25 Removing & Replacing a Disk Drive

Disk Drive Filler Panels

NOTE:

- The same disk drive filler panels are used in both the controller enclosure and the JBOD enclosure.
 - Your disk drive filler panel is one of two types: Type A has a blue release tab (Figure 25, A) and is captured and held in place by a cam lever, like a disk drive. Type B has a fixed gray tab (Figure 26, B) and is captured and held in place by cantilever clips.
-

Removing a Disk Drive Filler Panel

CAUTION: Do not operate the array for more than 5 minutes with a disk drive or filler panel removed. Either a disk drive or filler panel must be installed in the slot to maintain proper airflow.

Type A - See “Removing a Disk Drive” in this chapter.

Type B - Place your index finger under the handle (Figure 26, 1) and pull the disk drive filler panel (2) straight out of the slot.

Replacing a Disk Drive Filler Panel

Type A - See “Removing a Disk Drive” in this chapter.

Type B - Push the disk drive filler panel (Figure 26, 2) straight into the slot until it clicks into place.

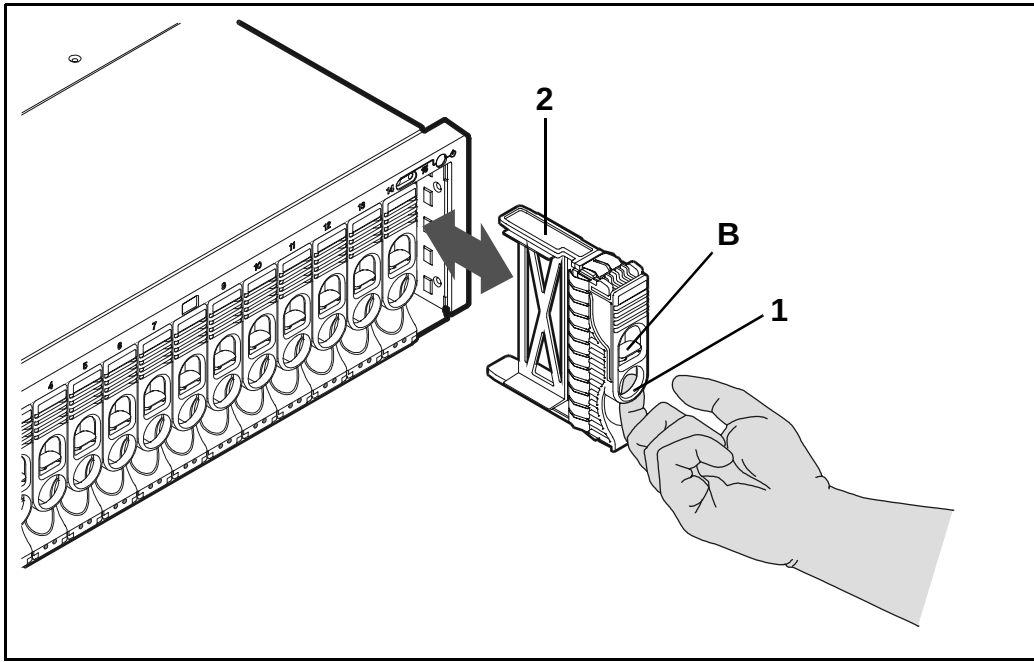


Figure 26 Removing & Replacing a Type B Disk Drive Filler Panel

Power Modules

Removing a Power Module

CAUTION: Do not operate the array for more than 2 minutes with a power module removed, or the array may automatically initiate a Shutdown. At least one power module must be installed and operational at all times to maintain adequate power and airflow.

1. Disconnect the power cord.
2. Loosen the cam lever screws (Figure 27, 1) with a T-10 driver or flat-blade screwdriver.
3. Pull out both cam levers (2) at the same time.
4. Pull the power module (3) out of the slot.

Replacing a Power Module

1. Pull out both cam levers (Figure 27, 2) at the same time.
2. Push the power module (3) firmly into the slot.
3. Push in both cam levers at the same time.
4. Tighten the cam lever screws (1) with a T-10 driver or flat-blade screwdriver.
5. Re-connect the power cord.

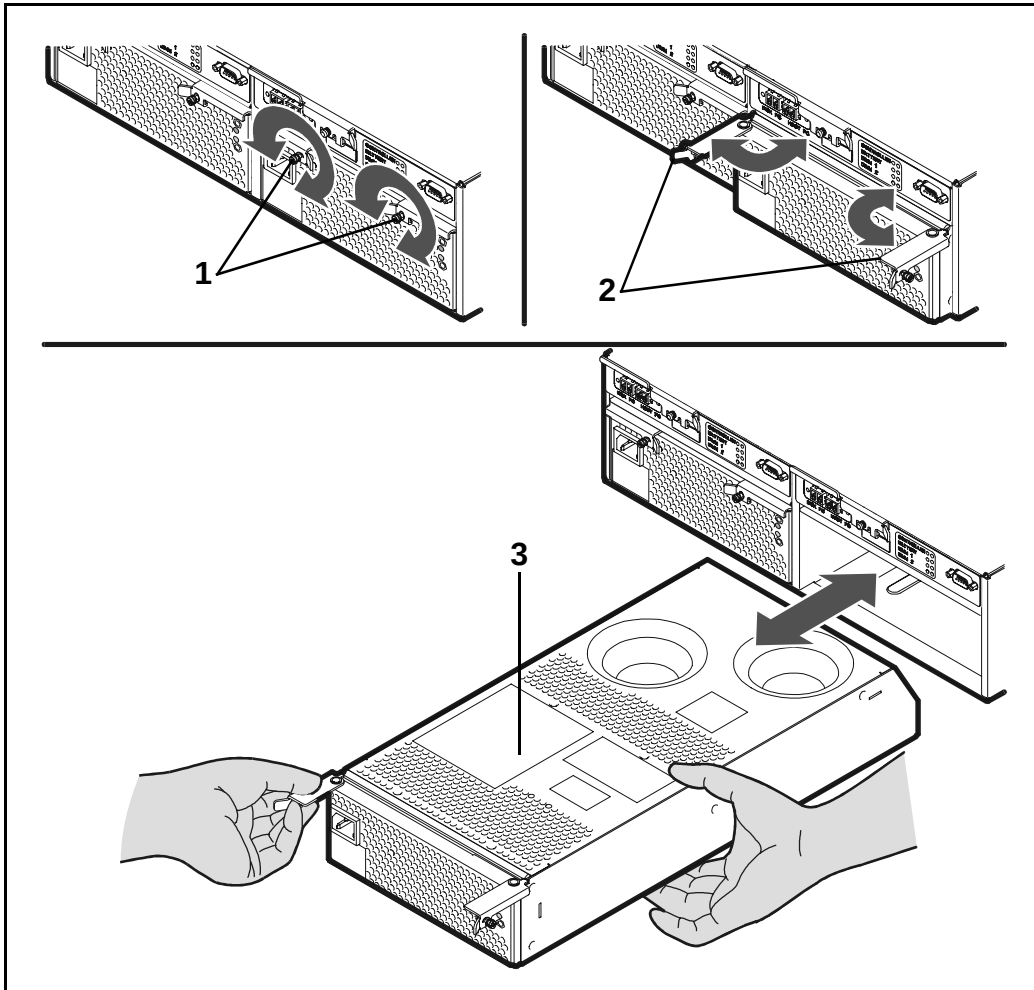


Figure 27 Removing & Replacing a Power Module (Controller Enclosure)

Fiber Optic Cables

CAUTION: To prevent damage to fiber optic cables: 1) Do not exceed a bend radius of 2 inches (5.1 cm). 2) Grasp the connector when disconnecting a fiber optic cable; never pull on the cable. 3) Install fiber optic covers (see Figure 28) after a cable is removed.

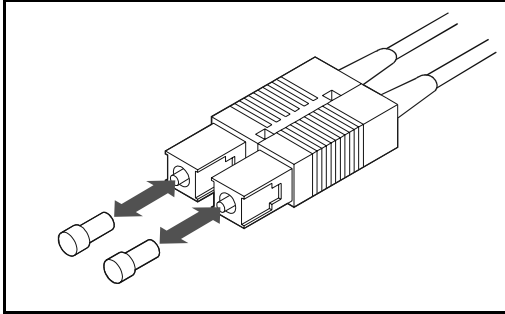


Figure 28 Fiber Optic Covers

Removing & Replacing Fiber Optic Cables

See Figure 29 and Figure 30 to remove and replace fiber optic cables.

NOTE:

Your array controller uses one of two types of fiber optic cable connectors:

- SC connectors (Figure 29, 1) are large form factor connectors that plug into the GBIC (Figure 29, 2) on Type A array controller cards. The GBIC then plugs into the HOST FC connector on the array controller card.
 - LC connectors (Figure 30, 1 and 2) are small form factor connectors that plug directly into the DISK FC and HOST FC connectors on Type B array controller cards.
 - Both SC and LC connectors are keyed to install only one way.
-

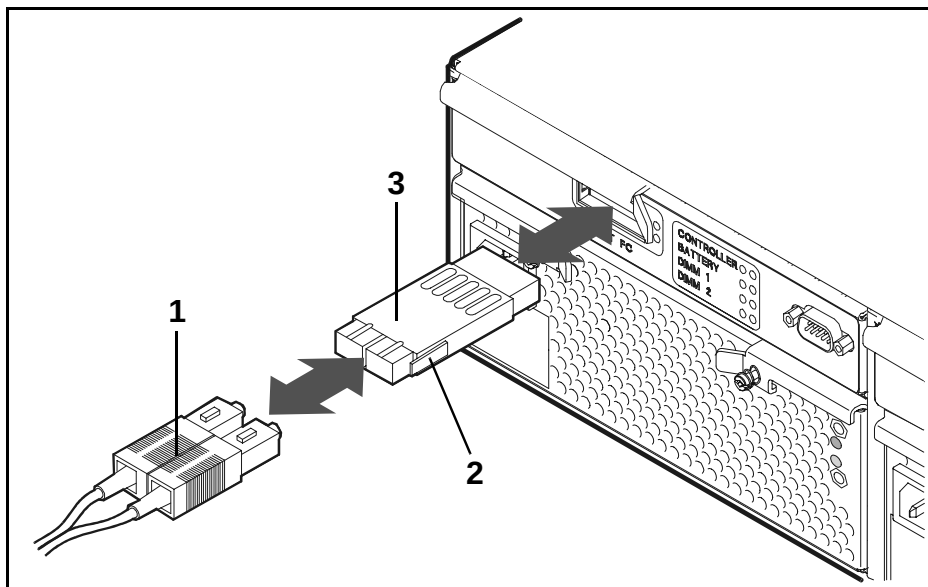


Figure 29 Removing & Replacing a Fiber Optic Cable & GBIC (Type A Array Controller Card)

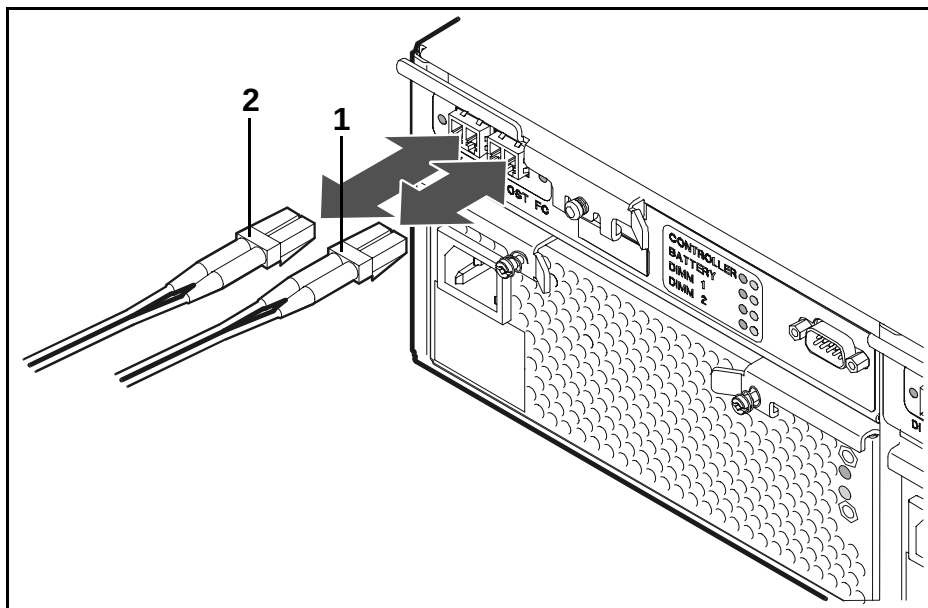


Figure 30 Removing & Replacing Fiber Optic Cables (Type B Array Controller Card)

Gigabit Interface Converters (Type A Array Controllers Only)

CAUTION: To prevent data transmission problems, always leave the GBIC cover installed until you are ready to connect the fiber optic cable to the GBIC (see Figure 31).

Removing a GBIC

1. Remove the fiber optic cable (Figure 29, 1).
2. Push in the GBIC tabs (Figure 29, 2) and gently pull the GBIC (3) out of the HOST FC slot.

Replacing a GBIC

1. Remove the GBIC cover (Figure 31).
2. With even pressure, gently push the GBIC (Figure 29, 3) into the HOST FC slot until it clicks into place.
3. Replace the fiber optic cable (Figure 29, 1).

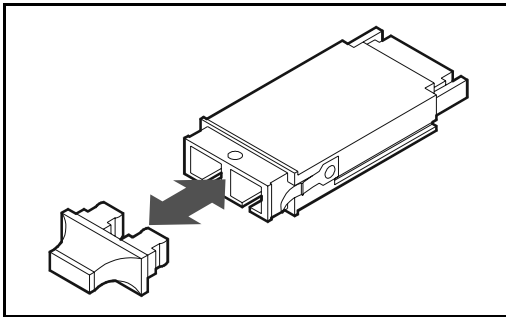


Figure 31 GBIC Cover

Array Controller Cards

Your array includes one of two types of array controller cards: Type A or Type B (see Table 22).

Table 22 Type A & Type B Array Controller Cards

Type	Product	Data Rate	JBODs Supported
A	VA 7100	1 Gbit/s	0
B	VA 7400	1 or 2 Gbit/s*	0-6

*Default is 1 Gbit/s; 2 Gbit/s set via the Virtual Front Panel.

Removing an Array Controller Card (HP Service Personnel Only)

CAUTION:

- The array controller card can be damaged by electrostatic discharge. Use the ESD kit provided when removing and replacing an array controller card.
- To prevent data loss, it is recommended that a full backup be performed before removing an array controller card.
- Do not operate the array for more than 5 minutes with an array controller card or filler panel removed. Either an array controller card or filler panel must be installed to maintain proper airflow in the controller enclosure. Use the foam in the replacement array controller card packaging to temporarily plug the empty slot.

-
1. Follow the flowchart in Figure 32.
 2. **Type A:** Remove the fiber optic cable from the GBIC (see Figure 29). **Type B:** Remove the fiber optic cables from the DISK FC and HOST FC connectors (see Figure 30).
 3. **Type A only:** Remove the GBIC (see Figure 29, 3).

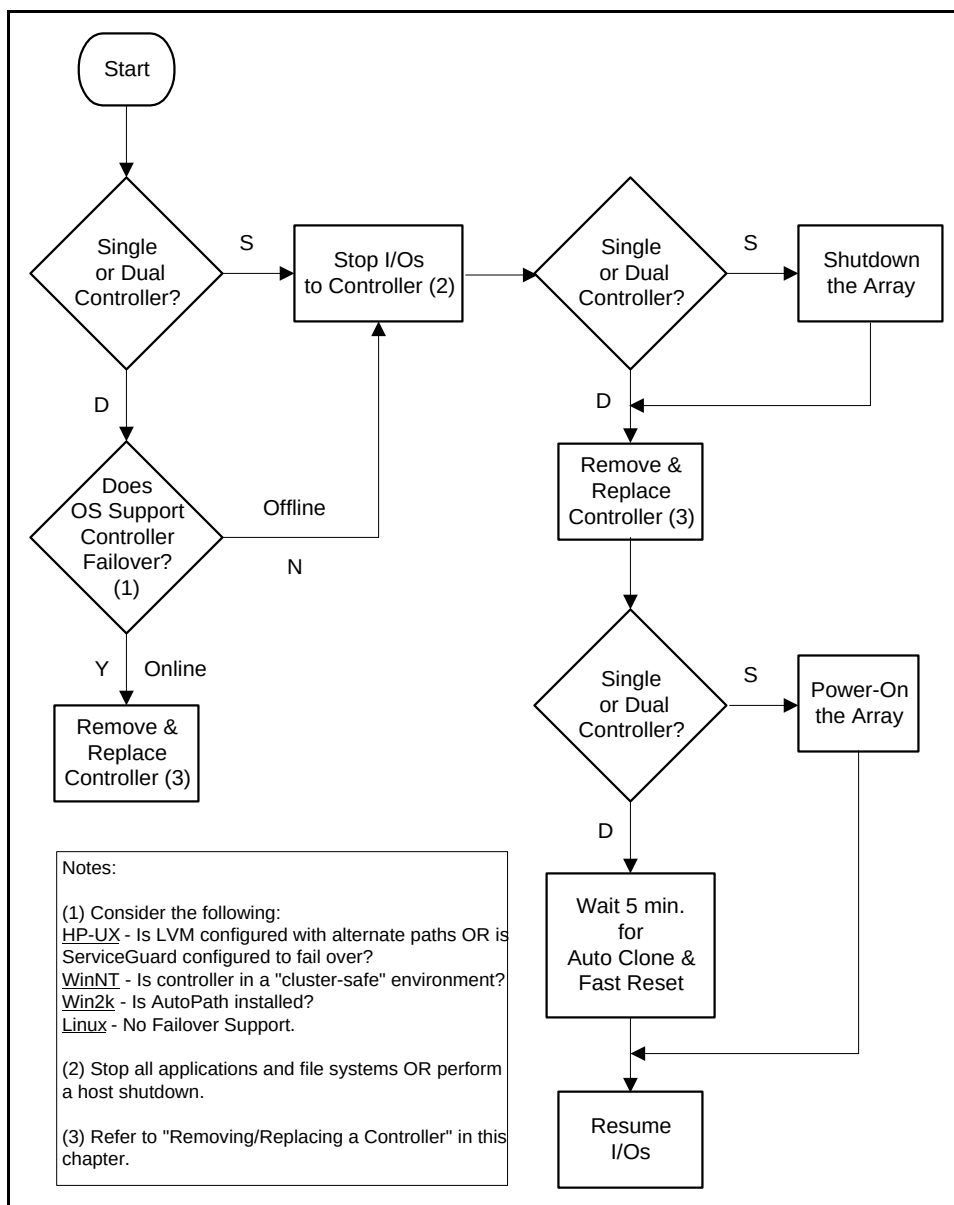


Figure 32 Array Controller Card Removal & Replacement Flowchart

4. **Type A:** Slide the latch (Figure 33, 1) all the way to the left. **Type B:** Loosen the cam lever screw (Figure 34, 1) with a T-10 driver or flat-blade screwdriver.
5. **Type A:** Press down the lock (Figure 33, 2) and pull out the cam lever (3). **Type B:** Pull out the cam lever (Figure 34, 2).

WARNING: A hot surface is located on the underside of the array controller card by the middle of the right-hand edge (facing the rear panel). To avoid burn injury, only touch the edges of the array controller card; do not touch the underside.

CAUTION: When the cam lever is pulled out, an early warning switch is activated which suspends mirroring between dual controllers and terminates all I/Os to the controllers.

6. Grasp the cam lever and slide the array controller card out 4 inches (10 cm) (Figure 33 or Figure 34).
7. Grasp the edges of the array controller card with both hands and pull it out of the slot.
8. **If the array controller card was removed for a DIMM failure (DIMMs no longer functional):**
Go to “Replacing an Array Controller Card” in this chapter.

If a DIMM failure did not occur (DIMMs still functional):

- a. Remove the battery from the removed array controller card (see “Removing an Array Controller Battery” in this chapter).
- b. Remove the DIMMs from the removed array controller card (see “Removing an Array Controller DIMM” in this chapter).

Replacing an Array Controller Card (HP Service Personnel Only)

CAUTION:

- The array controller card can be damaged by electrostatic discharge. Use the ESD kit provided when removing and replacing an array controller card.
 - If the green BATTERY LED is flashing and you remove a DIMM, damage to the array controller card or DIMM may occur.
-

NOTE: In a dual array controller configuration, if a controller is hot swapped, an Auto Clone process copies firmware from the remaining controller to the new controller, even if the new controller has a newer revision of firmware. When the Auto Clone process has completed, a Fast Reset process mirrors the memory from the remaining controller to the new controller.

1. If the green BATTERY LED on the new or upgrade array controller card is off, go to step 2. If the green BATTERY LED on the new or upgrade array controller card is flashing with a 5% duty cycle (battery fully charged), disconnect the battery from the battery terminal (see “Removing an Array Controller Battery” in this chapter), then reconnect it and verify that the green BATTERY LED is off.
-

NOTE: Disconnecting the battery from the array controller card resets a bit on the array controller card which disables battery power to the DIMMs.

2. Either install new DIMMs (ordered separately) on the new array controller card or transfer functional DIMMs from the old controller card to the new controller card (see “Replacing an Array Controller DIMM” in this chapter).
 3. **Type A only:** Slide the latch (Figure 33, 1) all the way to the left.
 4. **Type A:** Press down the lock (Figure 33, 2) and pull out the cam lever (3). **Type B:** Pull out the cam lever (Figure 34, 2).
 5. Grasp the edges of the array controller card with both hands and push it firmly into the slot. (Figure 33 or Figure 34).
 6. Push in the cam lever (Figure 33, 3 or Figure 34, 2) until it clicks into place.
 7. **Type A only:** Slide the latch (Figure 33, 1) all the way to the right.
 8. **Type B only:** Tighten the cam lever screw (Figure 34, 1).
 9. **Type A only:** Replace the GBIC (Figure 29, 3).
 10. Replace the fiber optic cables (see Figure 29 or Figure 30).
-

NOTE: If you need to change the default Fibre Channel Loop ID on the array controller card, use the following Virtual Front Panel command:

```
vfpmgr -L <loop id> -c <array controller card number>
```

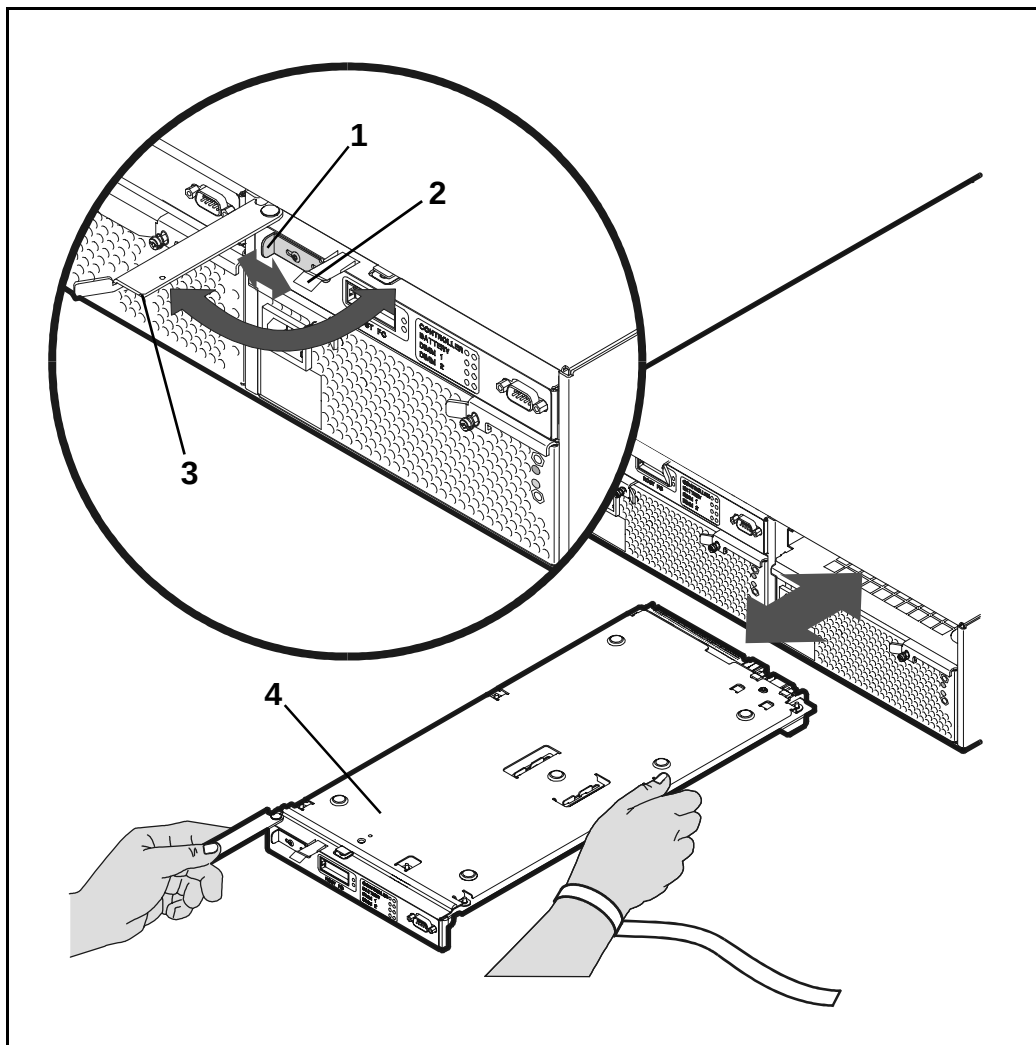


Figure 33 Removing & Replacing a Type A Array Controller Card

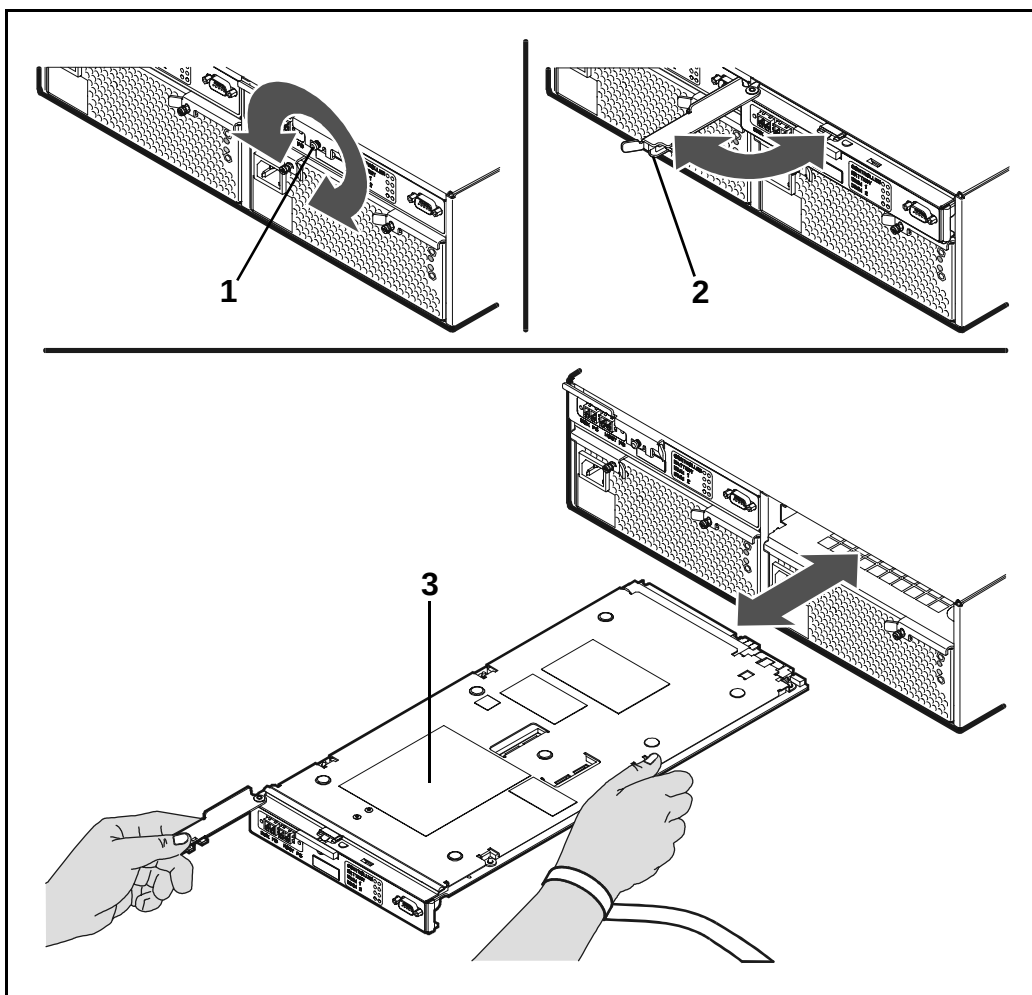


Figure 34 Removing & Replacing a Type B Array Controller Card

Array Controller Filler Panels

Removing an Array Controller Filler Panel

CAUTION: Do not operate the array for more than 5 minutes with an array controller or filler panel removed. Either an array controller or filler panel must be installed in the slot to maintain proper airflow.

1. Loosen the cam lever screws (Figure 35, 1) with a T-10 driver or flat-blade screwdriver.
2. Pull out both cam levers (2) at the same time.
3. Pull the array controller filler panel (3) out of the slot.

Replacing an Array Controller Filler Panel

1. Pull out both cam levers (Figure 35, 2) at the same time.
2. Push the array controller filler panel (3) firmly into the slot.
3. Push in both cam levers at the same time.
4. Tighten the cam lever screws (Figure 35, 1).

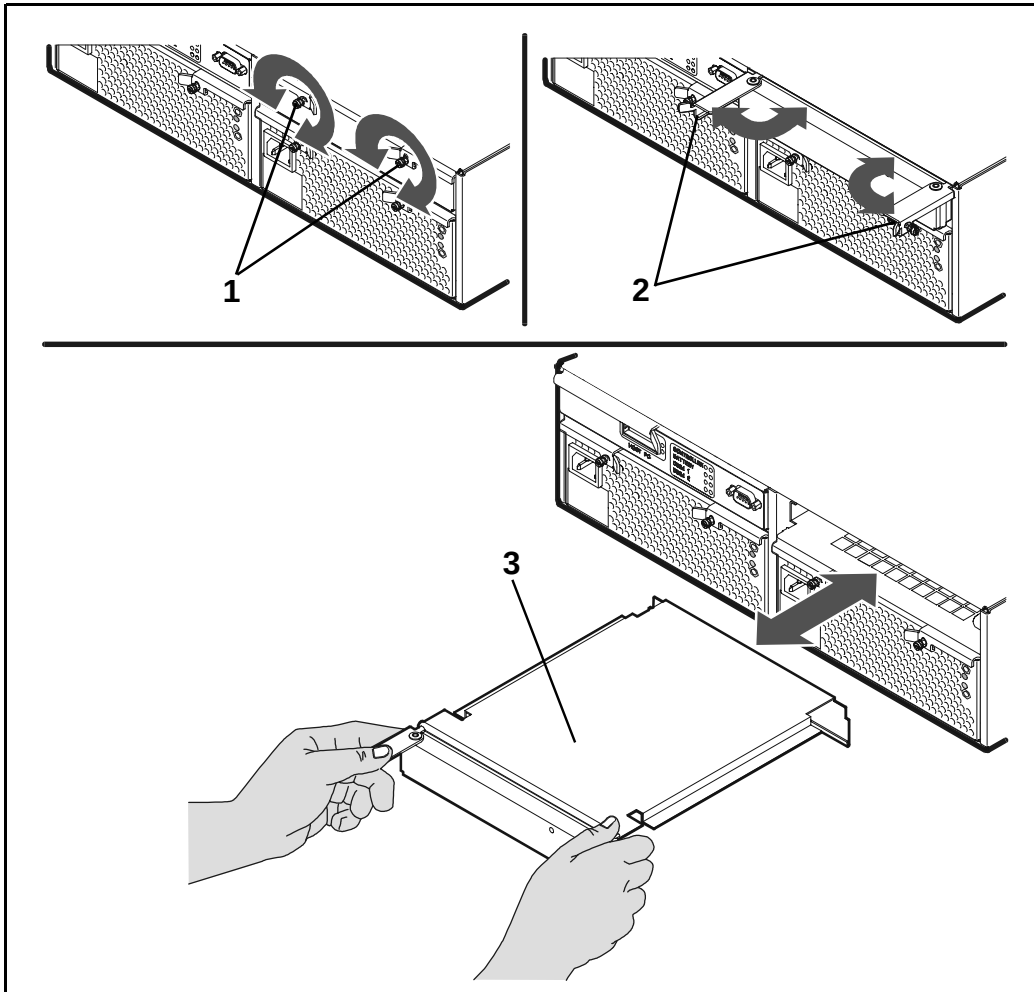


Figure 35 Removing & Replacing an Array Controller Filler Panel

Array Controller Batteries

CAUTION:

- Removing an array controller battery may cause data loss. The battery supplies power to the DIMMs on the array controller card. To prevent data loss, you must either ensure the array is in a dual array controller configuration, or you must perform an array Shutdown.
 - If the array is in a dual array controller configuration, it is recommended that you replace both array controller batteries.
 - The array controller battery is a Lithium ion type. When removed, the battery must be recycled or disposed of properly. Replace the battery only with the same type.
 - Shelf life for the array controller battery is rated for up to 6 months at a maximum temperature of 25° C. If this storage temperature or duration is exceeded, it may be necessary to recharge the battery during normal operation of the controller.
-

Removing an Array Controller Battery

1. Remove the array controller card (see “Removing an Array Controller Card” in this chapter).
2. Loosen the battery clamp screw (Figure 36, 1) with a T-20 driver.
3. Lift the battery clamp (Figure 36, 2) off of the battery.
4. Lift the battery connector (Figure 37, 1) off of the battery terminal (Figure 37, 2).
5. Lift the battery (Figure 37, 3) off of the array controller card.

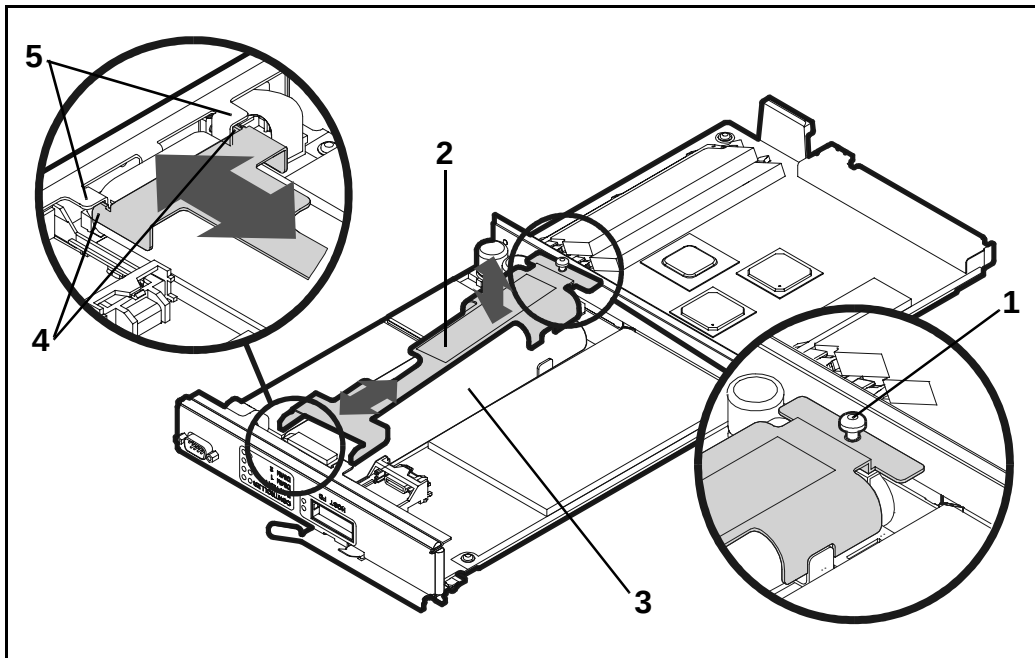


Figure 36 Removing & Replacing an Array Controller Battery

Replacing an Array Controller Battery

1. Seat the battery connector (Figure 37, 1) on the battery terminal (2).
2. Lay the battery (Figure 37, 3) on the foam pad (4) and in the battery bracket (5).
3. Place the battery clamp (Figure 36, 2) on the battery (3).
4. Slide the battery clamp forward so that the front tabs (Figure 36, 4) are positioned under the bulkhead tabs (5).
5. Tighten the battery clamp screw (Figure 36, 1) with a T-20 driver.
6. Replace the array controller card (see “Replacing an Array Controller Card” in this chapter).

NOTE: If the array controller battery was replaced on a single array controller, wait for the battery to charge before resuming I/Os.

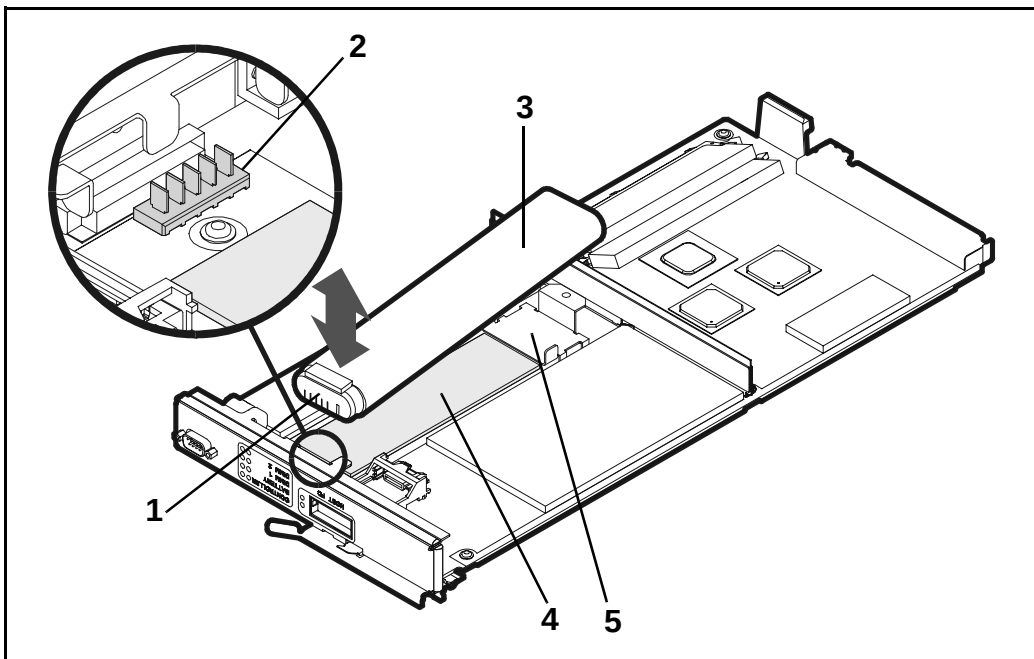


Figure 37 Connecting an Array Controller Battery

Array Controller DIMMs

Removing an Array Controller DIMM (HP Service Personnel Only)

CAUTION: DIMMs can be damaged by electrostatic discharge. Use the ESD kit provided when removing and replacing DIMMs.

1. Remove the array controller card (see “Removing an Array Controller Card” in this chapter).
2. Remove the battery (see “Removing an Array Controller Battery” in this chapter).

CAUTION: The battery must be removed to ensure there is no power to the DIMMs and to prevent damage to DIMMs caused by voltage spikes. After removing the battery, wait 2 minutes before removing DIMMs. This allows residual current to drain from the DIMMs.

3. Use your thumbs to pull out both DIMM extraction levers (Figure 38, 1) at the same time. The DIMM will automatically pop out of the DIMM slot.
4. Remove the DIMM (2) from the slot.

Replacing an Array Controller DIMM (HP Service Personnel Only)

CAUTION:

- DIMMs can be damaged by electrostatic discharge. Use the ESD kit provided when removing and replacing DIMMs.
 - To avoid interference when replacing DIMMs, always load the DIMM 1 slot first (see Figure 38, 2).
 - Replacement DIMMs must have the same memory size as the DIMMs being replaced. Otherwise, the array controller will report a “Memory Mismatch”. If the array is powered-on after the array controller is replaced offline, power-on initialization will not complete if the DIMM memory in both array controllers does not match.
-

1. Insert the DIMM (Figure 38, 2) evenly into the DIMM slot.
2. Use your thumbs to apply even pressure to the top edge of the DIMM and push the DIMM firmly into the slot. The DIMM extraction levers (1) will automatically capture the DIMM.
3. Replace the battery (see “Replacing an Array Controller Battery” in this chapter).
4. Replace the array controller card (see “Replacing an Array Controller Card” in this chapter).

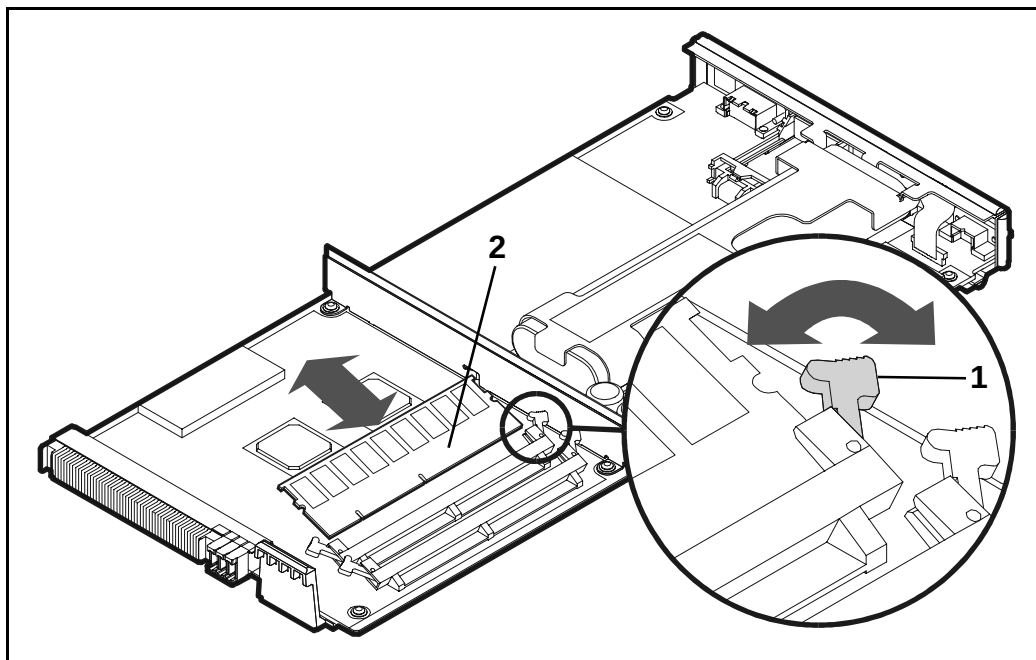


Figure 38 Removing & Replacing an Array Controller DIMM

Midplane Assembly

CAUTION:

- To prevent data loss, it is recommended that a full backup be performed before removing a midplane assembly.
 - The midplane assembly can be damaged by electrostatic discharge. Use the ESD kit provided when removing and replacing the midplane assembly.
 - The midplane assembly is tied directly to the enclosure. Once a midplane assembly has been installed in an enclosure, you cannot re-use it in another enclosure. The serial number and worldwide name (WWN) of the enclosure are stored in redundant EEPROMs on the midplane assembly.
-

Removing a Midplane Assembly (HP Service Personnel Only)

1. Perform an array Shutdown.
 2. Remove all of the disk drives (see “Removing a Disk Drive” in this chapter).
-

NOTE: The controllers and power modules do not need to be completely removed from the array chassis - only disengaged.

3. Disengage the array controller cards 1 inch (2.5 cm) from the midplane (see “Removing an Array Controller Card”).
 4. Disengage the power modules 1 inch (2.5 cm) from the midplane (see “Removing a Power Module” in this chapter).
 5. **Racked arrays only:** Remove the chassis mounting screws from the rack and pull the array chassis 2 inches (5 cm) out of the rack.
-

NOTE: Verify that pulling the array chassis out of the rack will not stress or damage the cables connected to the rear of the chassis.

Deskside arrays only: Remove the chassis from the deskside assembly (see *HP SureStore VA 7100 Deskside Assembly Conversion Kit Instructions*).

6. Remove the front bezel (Figure 39, 1).
7. Remove three T-10 screws (2) from the chassis top cover (6).

8. Using a flat-blade screwdriver, push up the two front top-cover side-clips (3) and pop the top cover up slightly.
9. Twist the screwdriver blade in the rear gaps (4) on the side of the chassis, directly behind the top cover.
10. Place a screwdriver blade in a vertical position in the slots (5) on top of the chassis directly behind the top cover. Hit the handle of the screwdriver with the palm of your hand until the top cover moves forward 3/16 inch (0.5 cm).
11. Slide the top cover (6) off the chassis.
12. Lift the lightpipe (7) out of the chassis slots and remove it from the chassis.
13. Press the power/standby switch shaft (8) all the way in and remove it from the chassis.
14. With the T-15 driver provided in the midplane assembly kit, remove 9 screws (9) from the midplane assembly.
15. Remove the midplane assembly (10) from the chassis.

Replacing a Midplane Assembly (HP Service Personnel Only)

NOTE: Replacing a midplane assembly is the reverse of removing a midplane assembly.

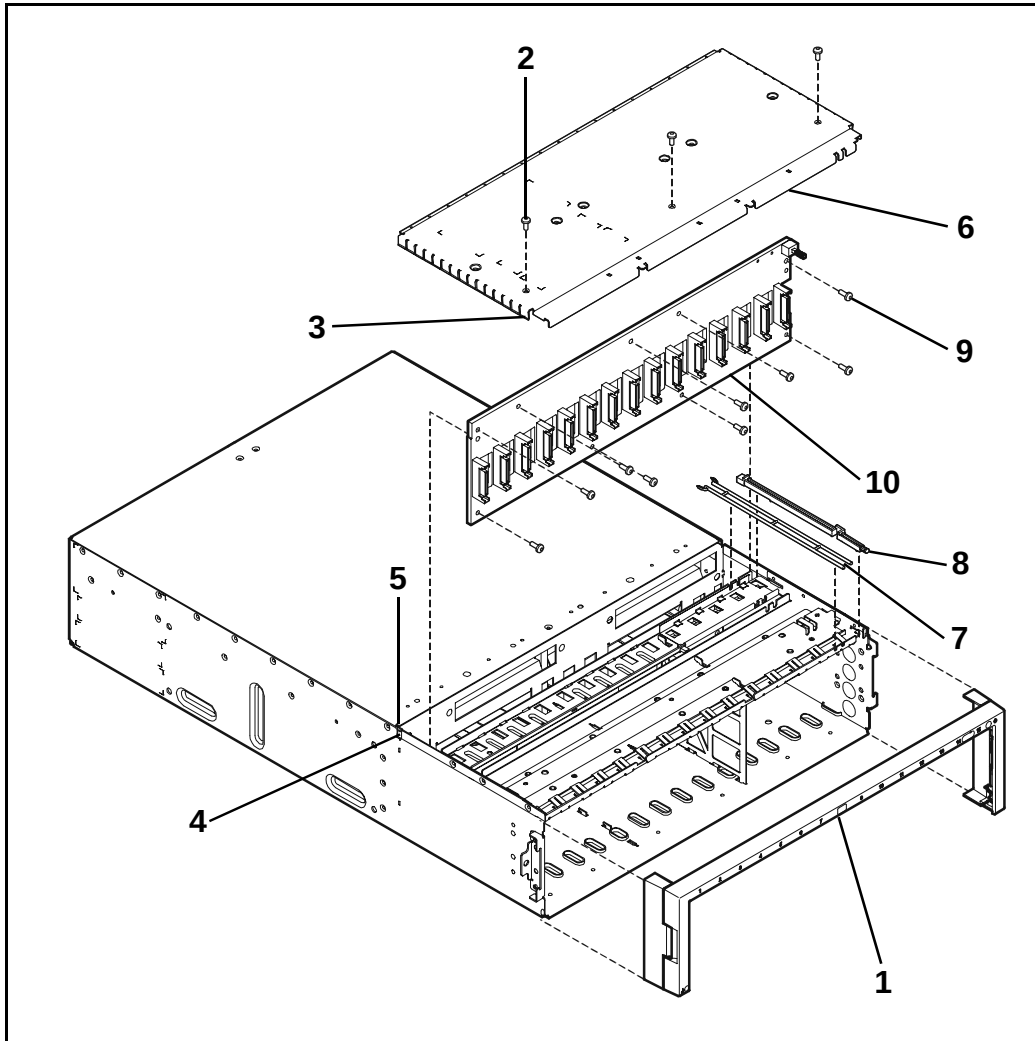


Figure 39 Removing & Replacing a Midplane Assembly

JBOD Enclosure Removal & Replacement Procedures

Disk Drives

NOTE: The controller enclosure and the JBOD enclosure both use the same disk drives. See “Disk Drives” under “Controller Enclosure FRUs” for information on removing and replacing disk drives.

Disk Drive Filler Panels

NOTE: The controller enclosure and the JBOD enclosure both use the same disk drive filler panels. See “Disk Drive Filler Panels” under “Controller Enclosure FRUs” for information on removing and replacing disk drive filler panels.

Power Modules

Removing a Power Module

CAUTION: Do not operate the array for more than 2 minutes with a power module removed, or the array may automatically initiate a Shutdown. At least one power module must be installed and operational at all times to maintain adequate power and airflow.

1. Disconnect the power cord.
2. Loosen the cam lever screws (Figure 40, 1) with a T-10 driver or flat-blade screwdriver.
3. Pull out both cam levers (2) at the same time.
4. Pull the power module (3) out of the slot.

Replacing a Power Module

1. Pull out both cam levers (Figure 40, 2) at the same time.
2. Push the power module (3) firmly into the slot.
3. Push in both cam levers at the same time.
4. Tighten the cam lever screws (1) with a T-10 driver or flat-blade screwdriver.
5. Re-connect the power cord.

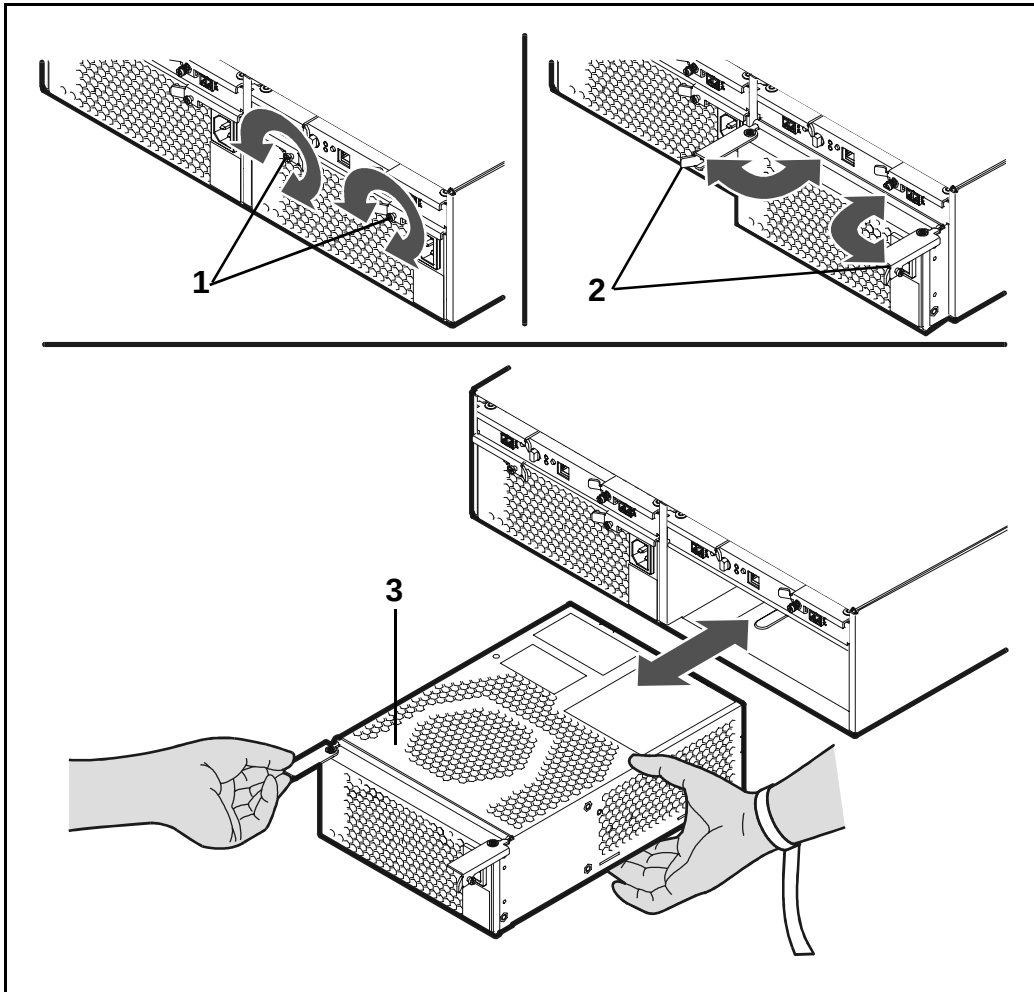


Figure 40 Removing & Replacing a Power Module (JBOD Enclosure)

Link Controller Cards (LCCs)

CAUTION:

- The LCC can be damaged by electrostatic discharge. Use the ESD kit provided when removing and replacing an LCC.
 - To prevent data loss, it is recommended that a full backup be performed before removing an LCC.
 - Do not operate the JBOD enclosure for more than 5 minutes with an LCC removed. An LCC must be installed in the slot to maintain proper airflow in the enclosure. Use the foam in the replacement LCC packaging to temporarily plug the slot.
-

Removing an LCC (HP Service Personnel Only)

1. Remove the fiber optic cables (Figure 41, 1 and 2).
-

NOTE: Depending on your configuration, Port 0 or Port 1 FC connectors may or may not have a fiber optic cable connected to it. Loopback cables are neither required nor recommended on unused FC connectors.

2. Loosen the cam lever screw (Figure 42, 1) with a T-10 driver or flat-blade screwdriver.
3. Pull out both cam levers (2) at the same time.
4. Pull the LCC (3) out of the slot.

Replacing an LCC (HP Service Personnel Only)

1. Pull out both cam levers (Figure 42, 2).
2. Push the LCC (3) firmly into the slot.
3. Push in both cam levers at the same time.
4. Tighten the cam lever screw (1).
5. Replace the fiber optic cables (Figure 41, 1 and 2).

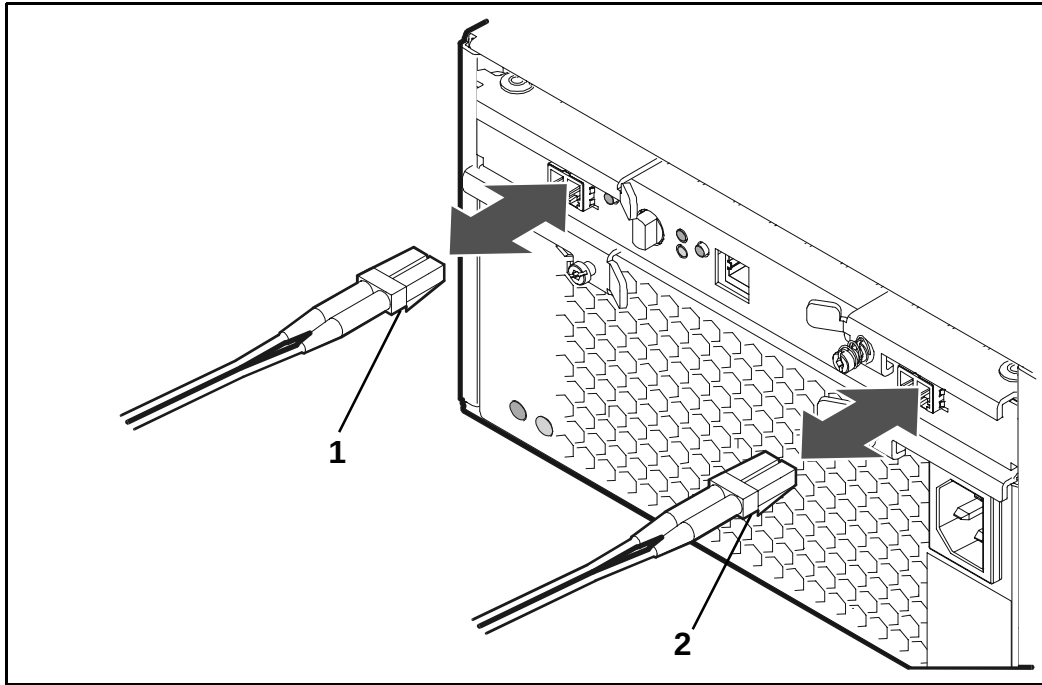


Figure 41 Removing and Replacing LCC Fiber Optic Cables

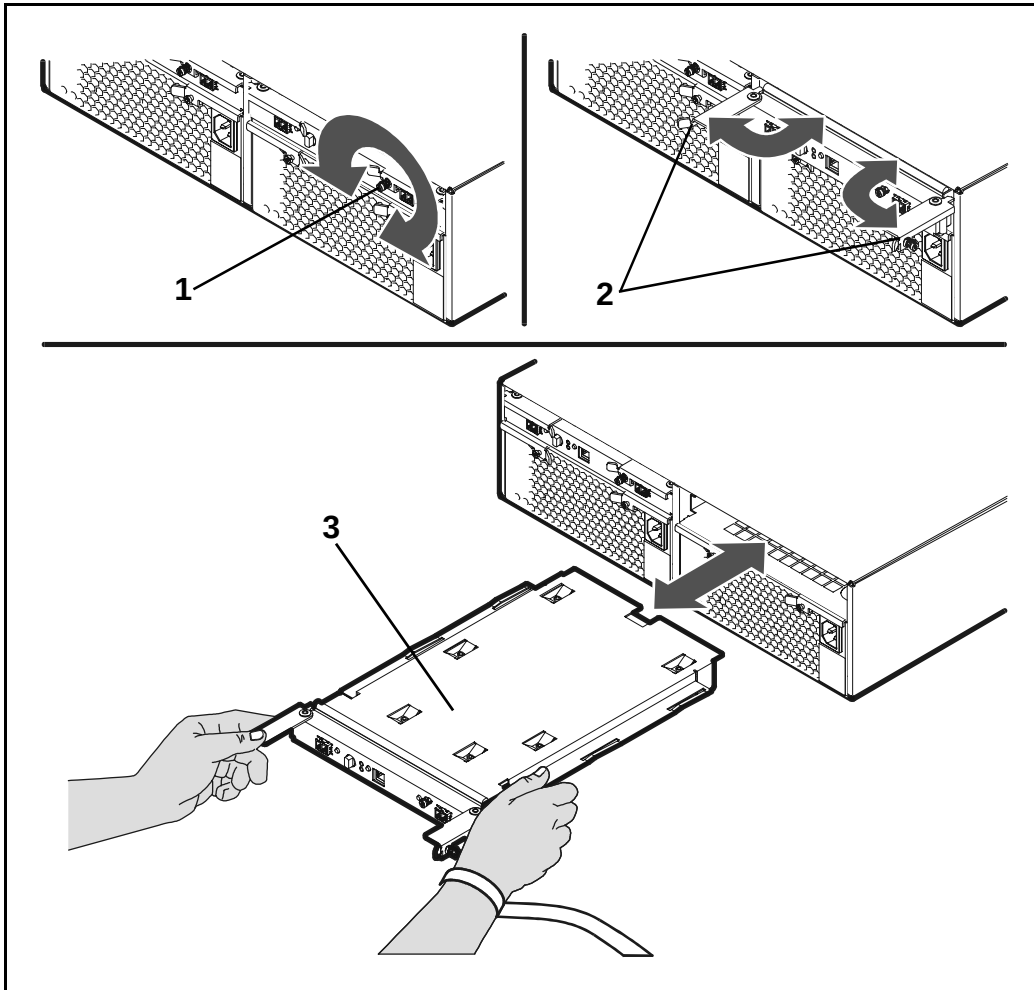


Figure 42 Removing & Replacing an LCC

Midplane Assembly

NOTE: The controller enclosure and the JBOD enclosure both use the same midplane assemblies. To remove and replace a midplane assembly in the JBOD enclosure, follow the steps under “Removing a Midplane Assembly” and “Replacing a Midplane Assembly” in this chapter, except in step 3, you will disengage (when removing) or re-engage (when replacing) the LCCs (see “Removing an LCC” in this chapter).

Upgrading the Array

Upgrading Storage Capacity

A new disk drive may be added online to the controller and JBOD enclosures at any time to upgrade storage capacity in the array. (See “Replacing a Disk Drive” in this chapter to add a disk drive). If the Auto Include feature is enabled, the array controller will automatically include the new disk in the array. However, a new logical drive must be created in order to make the new capacity available to the host.

Upgrading Single to Dual Array Controller Cards (HP Service Personnel Only)

CAUTION: To prevent data loss, it is recommended that a full backup be performed before starting this procedure.

An array with a single array controller can be upgraded to a dual array controller configuration by adding an upgrade array controller.

To upgrade from a single to a dual array controller configuration:

1. Install DIMMs (ordered separately) on the upgrade controller (see “Replacing an Array Controller DIMM” in this chapter).
2. Install the upgrade array controller (see “Replacing an Array Controller Card” in this chapter).

Upgrading Type A to Type B Array Controller Cards (HP Service Personnel Only)

The VA 7100 can be upgraded to a VA 7400 by upgrading its Type A array controller cards to Type B array controller cards. See “Removing an Array Controller Card” and “Replacing an Array Controller Card” in this chapter for procedures on removing a Type A array controller card and replacing it with a Type B array controller card.

Upgrading Array Controller DIMMs (HP Service Personnel Only)

CAUTION:

- To prevent data loss, it is recommended that a full backup be performed before starting this procedure.
 - The DIMM in slot 1 must have the same memory size as the DIMM in slot 2. Otherwise, the controller will report a “Memory Mismatch”.
-

Follow the steps under “Removing an Array Controller DIMM” and “Replacing an Array Controller DIMM” in this chapter. Table 23 shows valid DIMM configurations.

Table 23 Valid DIMM Configurations

Slot 1 DIMM (MB)	Slot 2 DIMM (MB)	Total DIMM Memory Size (MB)
256	X	256
256	256	512
512	X	512
512	512	1024

Upgrading Array Controller Card Firmware (HP Service Personnel Only)

CAUTION: To prevent data loss, it is recommended that a full backup be performed before starting this procedure.

NOTE: Array controller firmware can be downloaded while the array is online. On an HP-UX system, if you want to download firmware offline, use the Offline Diagnostics Environment (ODE).

1. **All Array Controller Configurations:** Download new firmware to an active array controller using *HP Command View SDM* software. (See “Upgrading Array Controller Firmware” in the Help System.)
 2. **Dual Array Controller Configurations Only:** Using the Auto Clone process, the new firmware is automatically copied from one array controller to the other array controller.
-

NOTE: When firmware microcode is fully downloaded, the array controller pauses I/Os for about 10 seconds, then switches to the new code.

Upgrading Link Controller Card Firmware (HP Service Personnel Only)

CAUTION: To prevent data loss, it is recommended that a full backup be performed before starting this procedure.

Download new firmware to an LCC using *HP Command View SDM* software. (See “Upgrading LCC Firmware” in the Help System.)

Upgrading Disk Firmware (HP Service Personnel Only)

CAUTION: To prevent data loss, it is recommended that a full backup be performed before starting this procedure.

Download new firmware to a disk drive using *HP Command View SDM* software. (See “Upgrading Disk Firmware” in the Help System.)

5. Specifications & Regulatory Statements

Physical, Electrical & Environmental Specifications

NOTE: See Table 1 in Chapter 1 for the composition of minimum and maximum configurations.

Table 24 VA 7100 & VA 7400 Racked Controller Enclosure Physical Specifications

Height	Width	Depth	Net Weight Min	Net Weight Max
5.0 in	17.6 in	26 in	75.0 lbs* 92.3 lbs**	103.5 lbs
128 mm	448 mm	660 mm	34.0 kg* 41.8 kg**	46.9 kg

*VA 7100

**VA7400

Table 25 VA 7100 Deskside Controller Enclosure Physical Specifications

Height	Width*	Depth	Net Weight Min	Net Weight Max
19.0 in	6.5 in	26.0 in	105 lbs	133.5 lbs
48.3 cm	166 mm	66.0 cm	47.6 kg	60.6 kg

*Base is 12.5 inches wide (317 mm).

Table 26 VA 7400 Racked JBOD Enclosure Physical Specifications

Height	Width	Depth	Net Weight Min	Net Weight Max
5.0 in	17.6 in	20 in	54.7 lbs	84.5 lbs
128 mm	448 mm	508 mm	24.8 kg	38.3 kg

Table 27 Controller & JBOD Enclosures Electrical Specifications

Electrical Parameter	Controller Enclosure	JBOD Enclosure
Voltage (Auto-Ranging)	100-127 Vac; 200-240 Vac	100-127 Vac; 200-240 Vac
Current (Maximum)*	6.85 A @ 100 Vac; 5.71 A @ 120 Vac; 3.43 A @ 200 Vac; 2.98 A @ 230 Vac	4.8 A @ 100 Vac; 4.0 A @ 120 Vac; 2.3 A @ 200 Vac; 2.1 A @ 230 Vac
Frequency	50/60 Hz	50/60 Hz
Inrush Current (Peak)	36 A	17.5 A
Power Consumption	670 W	500 W
Heat Dissipation	2288 BTU/hr	1611 BTU/hr
VA Rating	685 VA	500 VA

*Current rating is with 2 inputs

Table 28 Controller & JBOD Enclosures Environmental Specifications

Environmental Parameter	Controller Enclosure	JBOD Enclosure
Temperature	Op: 5° to 35° C (41° to 95° F) Non-Op: -40° to 70° C (-40° to 158° F)	Op: 5° to 40° C (41° to 104° F) Non-Op: -40° to 70° C (-40° to 158° F)
Temperature Gradient	20° C (68° F) per hour	20° C (68° F) per hour
Relative Humidity (Dry Bulb)	Op: 15% to 80% @ 35° C (95° F) Non-Op: 15% to 90% @ 35° C (95° F)	Op: 20% to 90% @ 26° C (78.8° F) Non-Op: 5% to 95% @ 65° C (149° F)
Shock	Op: 4g, 11 ms, half sine Non-Op: 2.5-inch drops per side (edge drop)	Op: 4g, 11 ms, 20 low-impulse pulses Non-Op: 1-inch edge drops per side
Vibration	Op: 0.21g-rms, 5 to 500 Hz random Non-Op: 2.09 g-rms, 5 to 500 Hz random Non-Op: 0.5 g-peak, 5 to 500 Hz swept sine	Op: 0.21g-rms, 5 to 500 Hz random Non-Op: 2.09 g-rms, 5 to 500 Hz random Non-Op: 0.5 g-rms, 5 to 500 Hz swept sine
Altitude	Op: 0 to 10,000 ft (0 to 3,048 m) Non-Op: 0 to 15,000 ft (0 to 4,572 m)	Op: 0 to 10,000 ft (0 to 3,048 m) Non-Op: 0 to 15,000 ft (0 to 4,572 m)
Acoustic (ISO 9296)	8.0 bel	8.0 bel

Regulatory Statements

Electromagnetic Compatibility Compliance

Table 29 Controller Enclosure Electromagnetic Compatibility Compliance

Parameter	Specification
Radiated & Conducted Emissions	FCC Class A & EN 55022:1998, CISPR-22: 1997 Level A
Immunity	EN 55024: 1998 / CISPR-24: 1997
Harmonic Current	IEC 61000-3-2: 1998 / EN 61000-3-2: 1995 + A14
Voltage Fluctuations & Flicker	IEC 61000-3-3: 1994 / EN 61000-3-3: 1995

Table 30 JBOD Enclosure Electromagnetic Immunity & ESD Compatibility Compliance

Parameter	Specification
Radiated Field Immunity: Frequencies & Field Strengths < 10 V/m Causing Functional Anomalies	No frequencies 14 kHz to 1 GHz cause functional anomalies.
ESD Immunity	No loss of function: 15 kV (maximum) No component damage: 25 kV (maximum)
Magnetic Field Immunity	Magnetic field susceptibility: 0.1 millitesla p-p, 47.5 to 198 Hz Non-op magnetic field interference: < 5.25 milligauss @ 15 ft
Line Voltage Dropout	The product is specified to operate at a minimum of 100 Vac.
Carryover Period	20 ms (minimum)
Input Distortion	10% THD (flat top, clipped sinusoid)
Surge Immunity	IEC 61000-4-5:1995
Voltage dips, short interruptions, and variations	IEC 61000-4-11:1994
Oscillatory wave immunity, ringwave and burst	IEC 61000-4-12:1995

FCC EMC Statement (USA)

The Federal Communications Commission (in 47 CFR 15.105) has specified that the following notice be brought to the attention of the users of this product.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. The end user of this product should be aware that any changes or modifications made to this equipment without the approval of the manufacturer could result in the product not meeting the Class A limits, in which case the FCC could void the user's authority to operate the equipment.

IEC EMC Statement (Worldwide)

This is a CISPR 22 Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

EMC Statement (Canada)

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Spécification ATI Classe A (France)

DECLARATION D'INSTALLATION ET DE MISE EN EXPLOITATION d'un matériel traitement de l'information (ATI), classé A en fonction des niveaux de perturbations radioélectriques émis, définis dans la norme européenne EN 55022 concernant la Compatibilité Electromagnétique.

VCCI EMC Statement (Japan)

この装置は、情報処理装置等電波障害自主規制協議会（V C C I）の基準に基づくクラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

This equipment is in the Class A category information technology equipment based on the rules of Voluntary Control Council For Interference by Information Technology Equipment (VCCI). When used in a residential area, radio interference may be caused. In this case, user may be required to take appropriate.

Harmonics Conformance (Japan)

高調波ガイドライン適合品

BSMI EMC Statement & License Number (Taiwan)

警告使用者：這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

檢磁 XXXXYXXX

XXXXYXXX = 3892H060 for Controller Enclosure

XXXXYXXX = 3902H045 for JBOD Enclosure

RRL Statement (Korea)

사용자 안내문 : A 급기기

이 기기는 업무용으로 전자파 적합등록을 받은 기기 이오니, 판매자 또는 사용자는 이점을 주의하시기 바라며, 만약 잘못 구입하셨을 때에는 구입한 곳에서 비업무용으로 교환하시기 바랍니다.

Class A Equipment: Please note that this equipment has been approved for business purpose with regards to electromagnetic interference. If purchased in error for use in a residential area, you may wish to exchange the equipment where you purchased it.

Acoustic Noise Emission Declaration (Germany)

Schalldruckpegel $L_p = 70 \text{ dB(A)}$

Am Arbeitsplatz (operator position)

Normaler Betrieb (normal operation)

Nach ISO 7779:1988 / EN 27779:1991 (Typprüfung)

Safety Compliance

- IEC 60950 Third Edition (1999)
- EN 60950
- CAN/CSA-C22.2 No. 60950-00 Third Edition
- UL 60950-2000

Electrical Safety

WARNING:

- The product power cords are used as main disconnect devices. To ensure that the power cords can be disconnected quickly, locate the product near an easily accessible power outlet.
 - Use only UL/CSA approved power cords, SVT type, rated for a suitable voltage and current. These power cords have two conductors and a ground. Failure to use the proper power cord may result in an electric shock or fire hazard.
 - To avoid a fire hazard, the ac branch service must be properly current-protected by either a fuse or a circuit breaker. Hewlett-Packard recommends the use of magnetic-type circuit breakers, which are capable of handling large inrush currents for short durations (10-12 ms) and are rated adequately for the steady state currents. Also, make sure all equipment is properly grounded.
-

Class 1 Laser Safety Statement

A. Certification and Classification Information

This product contains a laser internal to the Small Form Factor (SSF) module for connection to the Fibre communications port.

In the USA, the SSF module is certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation 21 CFR, Subchapter J. The certification is indicated by a label on the metallic SSF housing.

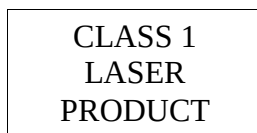
Outside the USA, the SSF is certified as a Class 1 laser product conforming to the requirements contained in IEC 825-1:1993 and EN 60825-1:1994, including Amendment 11:1996.

The SSF includes the following certifications:

* CSA Certified Component (Canada & US)

* TUV Certified Component (European Union)

The following figure shows the Class 1 information label that appears on the metal cover of the SSF housing:



B. Product Information

Each communications port consists of a transmitter and receiver optical subassembly. The transmitter subassembly contains internally a semiconductor laser diode at a wavelength of 850 nanometers. In the event of a break anywhere in the fibre path, the SSF control system prevents laser emissions from exceeding Class 1 levels.

Class 1 laser products are not considered hazardous.

WARNING: There are no user maintenance or service operations or adjustments to be performed on any SSF model.

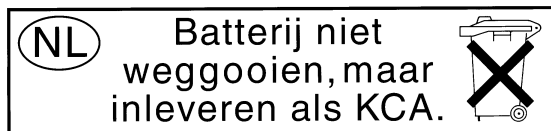
C. Usage Restrictions

Failure to comply with these usage restrictions may result in incorrect operation of the system and points of access may emit laser radiation above Class 1 limits established by the IEC and the U.S. DHHS.

Battery Disposal Statement (Worldwide, Controller Enclosure Only)

CAUTION: The Lithium Ion battery used in this product may be harmful to the environment if not disposed of properly. Please follow the local, state or country regulations regarding the proper disposal of these batteries.

Battery Disposal Statement (Netherlands, Controller Enclosure Only)



Bij dit produkt zijn batterijen geleverd. Wanneer deze leeg zijn, moet u ze niet weggooien maar inleveren als KCA.

Declaration of Conformity Statements

The following two pages include declarations of conformity for the controller enclosure and the JBOD enclosure.

NOTE: The JBOD enclosure is listed as the "Disk System 2400" in the Declaration of Conformity Statement on last page of this chapter.

DECLARATION OF CONFORMITY according to ISO/IEC Guide 22 and EN 45014	
Manufacturer Name:	Hewlett-Packard Company
Manufacturer Address:	Modular Network Storage Organization P.O. Box 15 Boise, Idaho U.S.A. 83707
Declares, that the product	
Product Name:	HP SureStore Virtual Array
Product Number(s):	A6183A/AD/AE/AZ, A6183-60100, A618pA, A619qA, A6203A, A6206A/AD/AZ, A6207A/AD/AZ, A622rA, A623sA, A6241A, A626tA/AE/AZ/P; p = 3,5-9; q = 1,2,4,6-8; r = 0-2, 4-6,8,9; s = 1,3-5; t = 1-5
Product Options:	All
conforms to the following Product Specifications:	
Safety:	EN 60950: 1991, Second Edition + A1, A2, A3, and A4 CAN/CSA - C22.2 No. 60950-00, Third Edition UL 1950: Third Edition IEC 60825-1: 1993 + A1 / EN 60825-1: 1994 + A11 Class 1 (Laser/LED) GB4943: 1995
EMC:	CISPR 22: 1997 / EN 55022: 1998 Class A CISPR 24: 1997 / EN 55024: 1998 IEC 61000-3-2: 1998 / EN 61000-3-2: 1995 + A14, Harmonic Current IEC 61000-3-3: 1994 / EN 61000-3-3: 1995, Voltage Fluctuations and Flicker GB9254: 1988
Supplementary Information:	The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly. 1.) This product was tested with a Hewlett-Packard Unix server host computer system.
	
BOISE, IDAHO U.S.A., 7/2/2001, Greg Hite / Hardware Test Laboratory Manager	
European contact for regulatory topics only:	Hewlett-Packard GmbH, HQ-TRE, Herrenberger Strasse 130, D-71034 Böblingen (FAX: +49-7031-14-3143)

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard
Company

Manufacturer's Address: 8000 Foothills Blvd.
Roseville, CA 95747
USA

declares, that the product

Product Name: Disk System 2400

Model Number(s): A6214A, A6214AE, A6214AZ, A6215A,
A6214-60100

Product Options: All

conforms to the following Product Specifications:

Safety: IEC 60950:1991 + A1, A2, A3, A4 / EN 60950:1992 + A1, A2,
A3, A4, A11

GB 4943-1995

IEC 60825-1:1993 / EN 60825-1:1994 + A11, Class 1
(Laser/LED)

EMC: CISPR 22:1997 +A1 / EN 55022:1998 + A1 Class A¹

GB 9254-1988

CISPR 24:1997 / EN 55024:1998

IEC 61000-3-2:1995 / EN 61000-3-2:1995 + A14

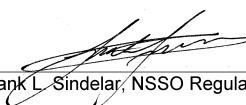
IEC 61000-3-3:1994 / EN 61000-3-3:1995

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE marking accordingly.

The Product was tested in a typical configuration with a Hewlett-Packard computer system and peripherals.

Roseville, July 5th, 2001


Frank L. Sindelar, NSSO Regulatory Mgr.

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH,
Department HQ-TRE, Herrenberger Straße 130, D-71034 Böblingen (FAX: + 49-7031-14-3143)

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